VICTORIAN CURRICULUM AND ASSESSMENT AUTHORITY

Victorian Certificate of Education 2011

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STUDENT NUMBER

									Letter
Figures									
Words									

BIOLOGY

Written examination 2

Friday 4 November 2011

Reading time: 9.00 am to 9.15 am (15 minutes)
Writing time: 9.15 am to 10.45 am (1 hour 30 minutes)

QUESTION AND ANSWER BOOK

Structure of book

Section	*Number of questions*	*Number of questions to be answered*	*Number of marks*
A	25	25	25
B	7	7	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 25 pages.
- Answer sheet for multiple-choice questions.

Instructions

- Write your **student number** in the space provided above on this page.
- Check that your **name** and **student number** as printed on your answer sheet for multiple-choice questions are correct, **and** sign your name in the space provided to verify this.
- All written responses must be in English.

At the end of the examination

- Place the answer sheet for multiple-choice questions inside the front cover of this book.

Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic devices into the examination room.

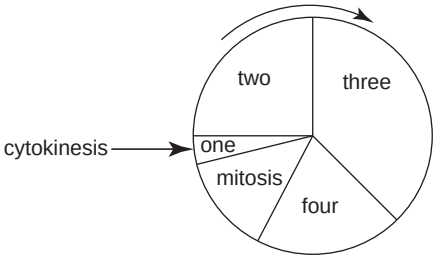
SECTION A – Multiple-choice questions

Instructions for Section A

Answer **all** questions in pencil on the answer sheet provided for multiple-choice questions.
Choose the response that is **correct** for the question.
A correct answer scores 1, an incorrect answer scores 0.
Marks will **not** be deducted for incorrect answers.
No marks will be given if more than one answer is completed for any question.

Question 1

The following diagram is a representation of the cell cycle.



Replication of DNA occurs in section

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

Question 2

Plasmids, prokaryotic chromosomes and eukaryotic chromosomes

A. are all circular in shape.
B. all replicate during mitosis.
C. are all composed of histone proteins.
D. are all made out of double-stranded DNA.

Question 3

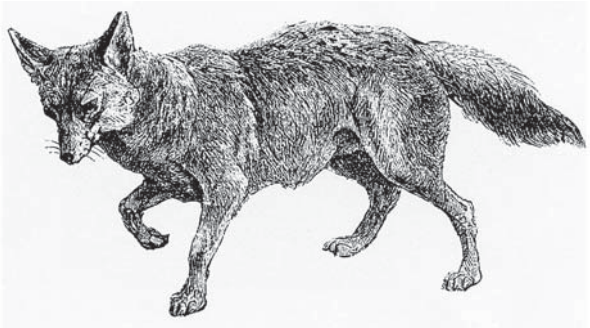
Defective alleles may result in genetic defects.
Replacement of a defective allele with a normal allele is called

A. cell cloning.
B. gene therapy.
C. a triplet change.
D. DNA replacement.

Question 4

Examine the following drawings.

Tasmanian tiger



American grey wolf

The Tasmanian tiger (now extinct) and the American grey wolf evolved independently of each other, but show similar physical structures and hunting behaviours.

The similarity between the two organisms is most likely a result of

A. homology.

B. genetic drift.

C. allopatric speciation.

D. convergent evolution.

Question 5

Stem cells

A. are used in human reproductive cloning.

B. are also called adult (somatic) cell types.

C. can be obtained from a 2 or 4 cell embryo.

D. can differentiate into a limited number of cell types.

Question 6

The process of apoptosis includes characteristic changes such as

A. uncontrolled death of cells.

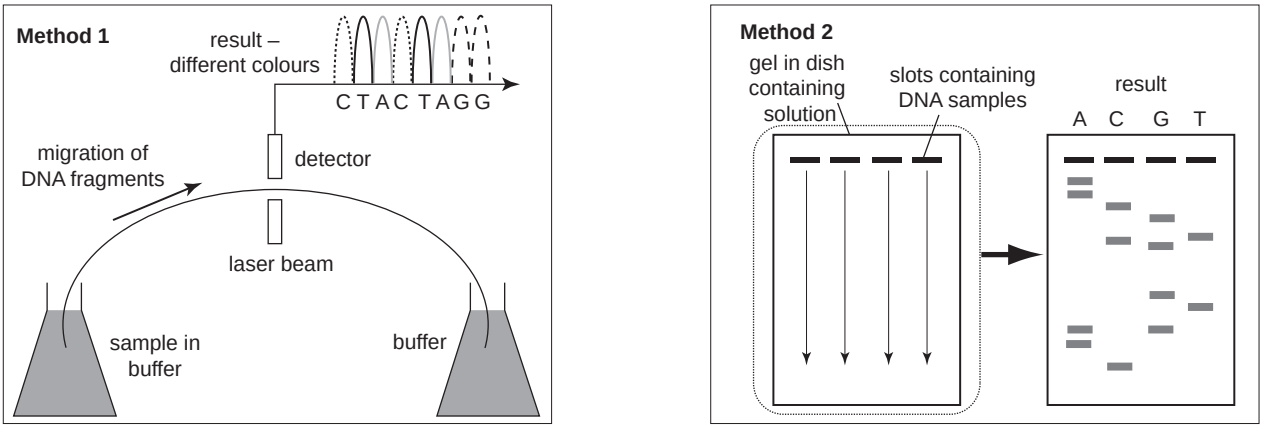
B. production of special enzymes.

C. development of cancerous diseases.

D. destruction of all organelles in cells.

Question 7

The following figures show two different methods used to sequence DNA.



It would be correct to conclude that

A. method 1 requires 4 slots for the loading of the DNA.

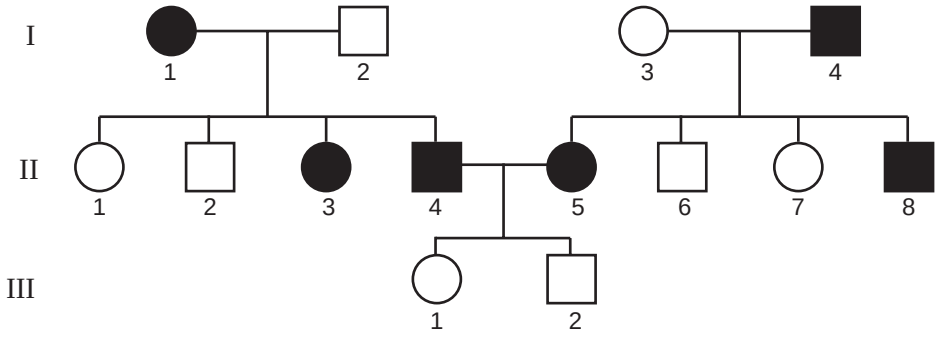
B. method 2 uses a laser beam to separate the individual nucleotides.

C. method 1 uses fluorescent dyes to distinguish between the different nucleotides.

D. method 2 requires the DNA to be loaded at the positive end on the sequencing gel.

Use the following information to answer Questions 8 and 9.

Examine the following pedigree.



Question 8

The mode of inheritance of the trait shown in the pedigree is

A. X-linked recessive.

B. X-linked dominant.

C. autosomal recessive.

D. autosomal dominant.

Question 9

If individuals II2 and II7 married, the chance that their first child would have the trait is

A. zero.

B. one in two.

C. one in three.

D. one in four.

Question 10

Cultural evolution

A. is a result of gene mutation.

B. may be transmitted by teaching.

C. can only occur after technological evolution.

D. occurs at a much slower rate than biological evolution.

Question 11

Radioactively labelled nucleotides were incubated with an unlabelled molecule of DNA. Appropriate enzymes were added and the DNA was allowed to replicate for two cycles. Examine the following key.

Unlabelled DNA	One strand labelled	Both strands labelled
		

Given that two cycles of DNA replication occurred, the end result would be

A. 

B. 

C. 

D. 

Question 12

The technique of carbon dating would be most suitable for dating organic remains that are aged

A. 4 000 000 000 years and beyond.

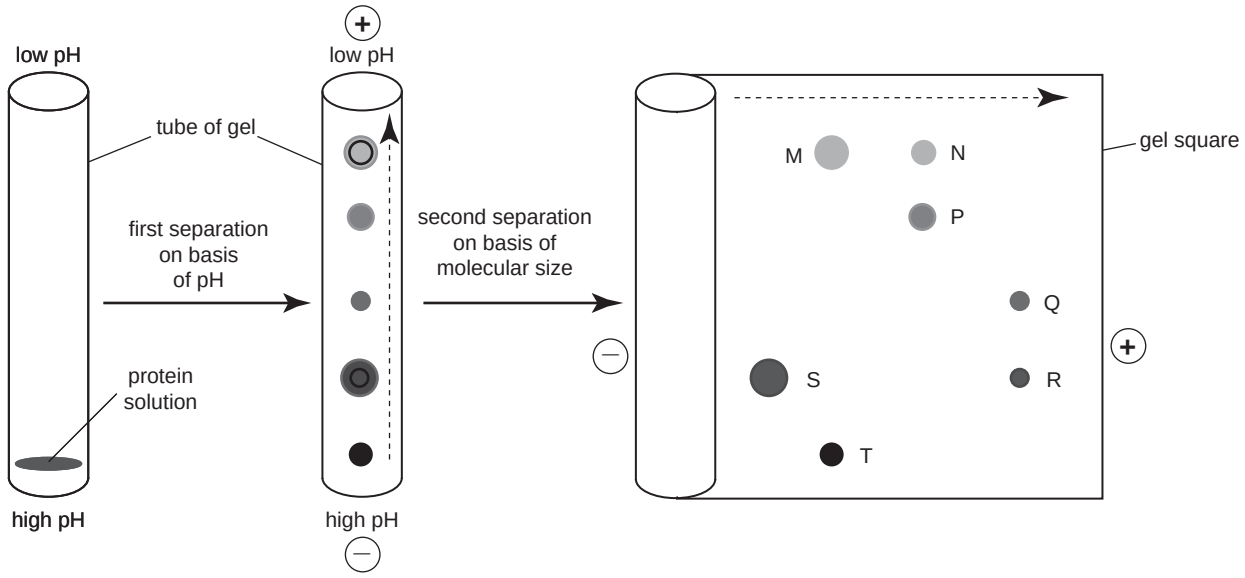
B. 4 000 000 years.

C. 400 000 years.

D. 40 000 years.

Question 13

Two-dimensional electrophoresis of proteins is one technique used to study the products of gene action within a cell. The first separation of proteins is based on pH and is carried out in a tube of gel. The second separation is carried out with a gel square and is based on molecular size.



The results of the electrophoresis indicate that

A. protein **N** has the same pH as protein **P**.

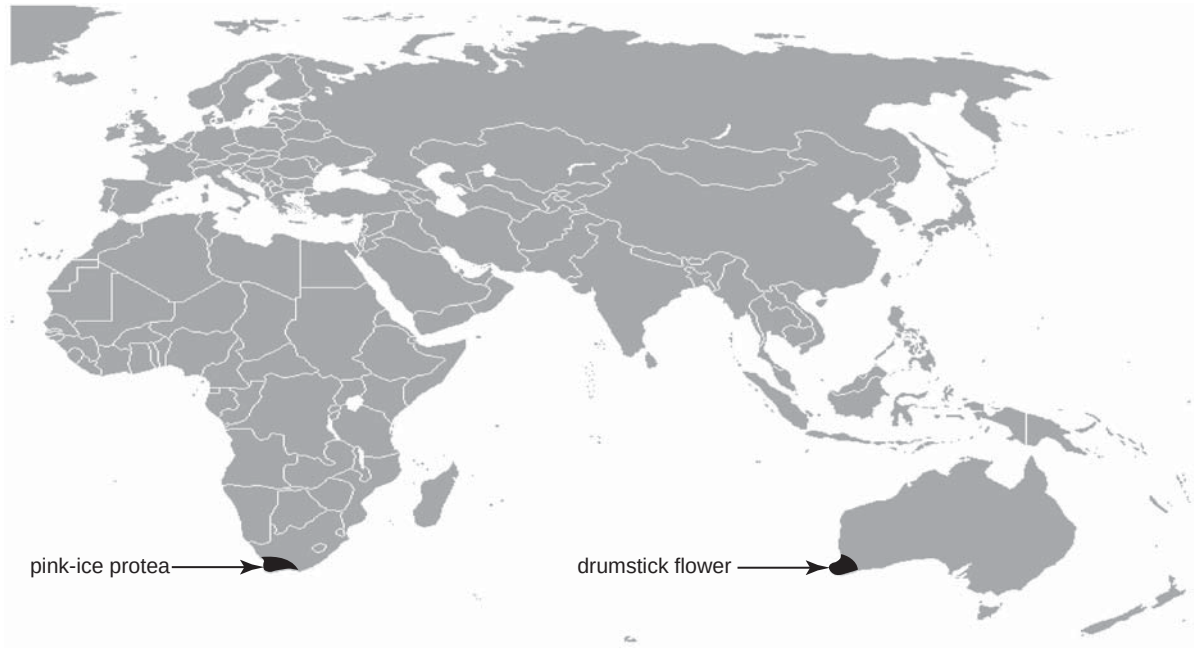
B. protein **T** has a lower pH than protein **M**.

C. protein **Q** has the same molecular size as protein **R**.

D. protein **M** has a greater molecular size than protein **S**.

Question 14

The Proteaceae family of plants contains the pink-ice protea, found in South Africa, and the drumstick flower found in Western Australia. The figure below shows their distribution.



No fossil evidence of the Proteaceae family has been found in the northern hemisphere.

This distribution is most likely due to

A. convergent evolution.

B. artificial selection.

C. continental drift.

D. founder effect.

Question 15

The term 'genome' applies best to all the

A. genes present in a cell.

B. organelles present in a cell.

C. proteins produced by a cell.

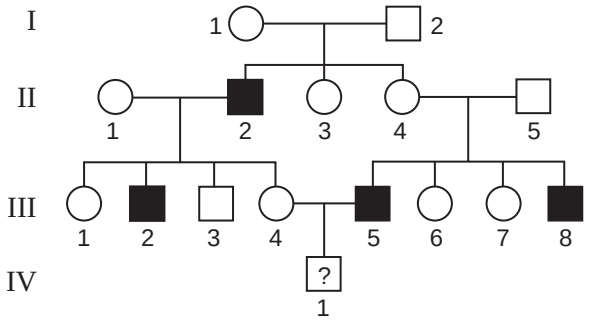
D. metabolites produced by a cell.

Question 16

Red-green colour blindness is an X-linked recessive trait with the alleles

X^R : normal colour vision
X^r : red-green colour blind

Examine the following pedigree.



With respect to this gene, it is reasonable to predict that individual

A. II3 must be $X^R X^R$.

B. III4 must be $X^R X^r$.

C. II4 has a two in three chance of being $X^R X^R$.

D. IV1 has a one in four chance of being colour blind.

Question 17

In leaf-cutting ants, a male develops from an unfertilised egg and a female from a fertilised egg.
It is reasonable to assume that

A. sperm produced by a particular male are genetically identical.

B. males can be either homozygous or heterozygous at any gene locus.

C. unfertilised eggs from a particular female develop into identical males.

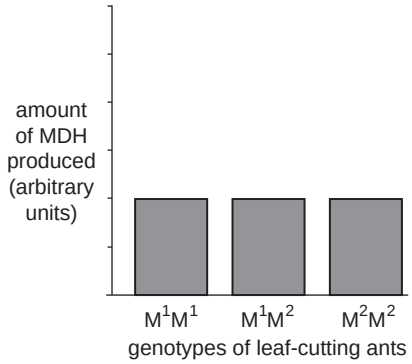
D. homologous pairs of chromosomes are found in both male and female ants.

Question 18

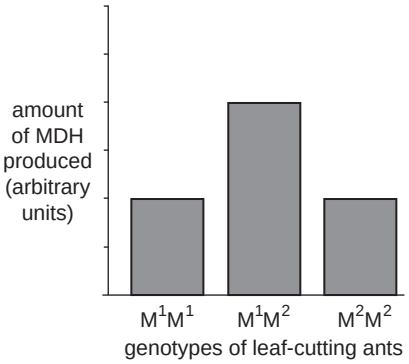
A gene in a leaf-cutting ant controls the production of the enzyme malate dehydrogenase (MDH). The gene locus has two alleles, M^1 and M^2. When these alleles are activated, each causes the production of an equal amount of MDH.

The phenotypes of the three genotypes possible, that is M^1M^1, M^1M^2 and M^2M^2, in a population of these ants, with respect to the production of MDH, is best represented by graph

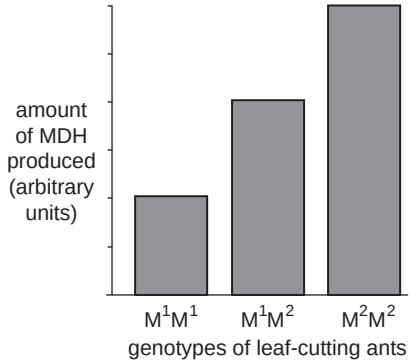
A.



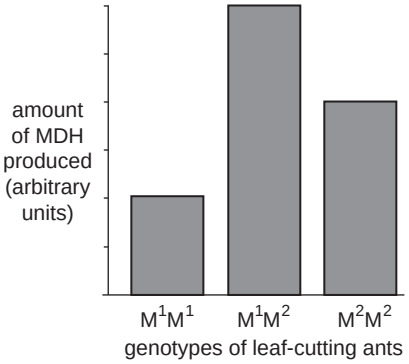
B.



C.

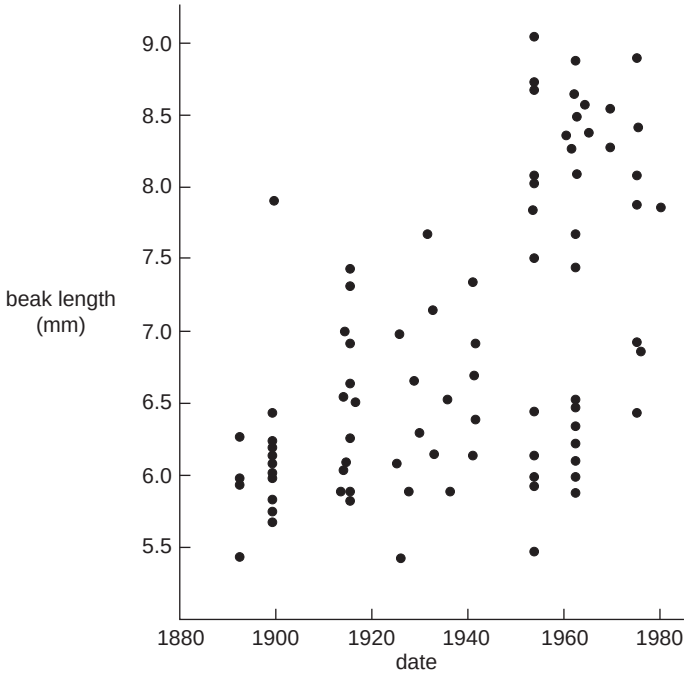


D.



Use the following information to answer Questions 19 and 20.

The soapberry bug (*Jadera haematoloma*) uses its long beak to penetrate the fleshy fruit of plants to feed on the seeds at the centre. The bug feeds on the native soapberry tree. The bug also feeds on the fruit of the introduced golden rain tree. Investigators measured the average beak length of the soapberry bug over eighty years. The results are shown below.



Question 19

From this information it would be reasonable to conclude that

A. the golden rain tree was introduced around 1970.

B. no long-beaked bugs existed prior to the introduction of the golden rain tree.

C. the diameter of the golden rain tree fruit acted as a selection pressure on beak length.

D. the response of an individual golden rain tree to predation by soapberry bugs would be to grow larger fruit.

Question 20

In neighbouring regions, the fruits of other introduced plants have also been used by the soapberry bug. Male and female soapberry bugs from different regions can interbreed. Evidence indicates that genetic isolation of some of these populations is gradually occurring.

The situation that would lead to an increase in genetic isolation would be if

A. different types of host plants have fruiting seasons which do not overlap.

B. pheromones of female soapberry bugs attract soapberry males from neighbouring populations.

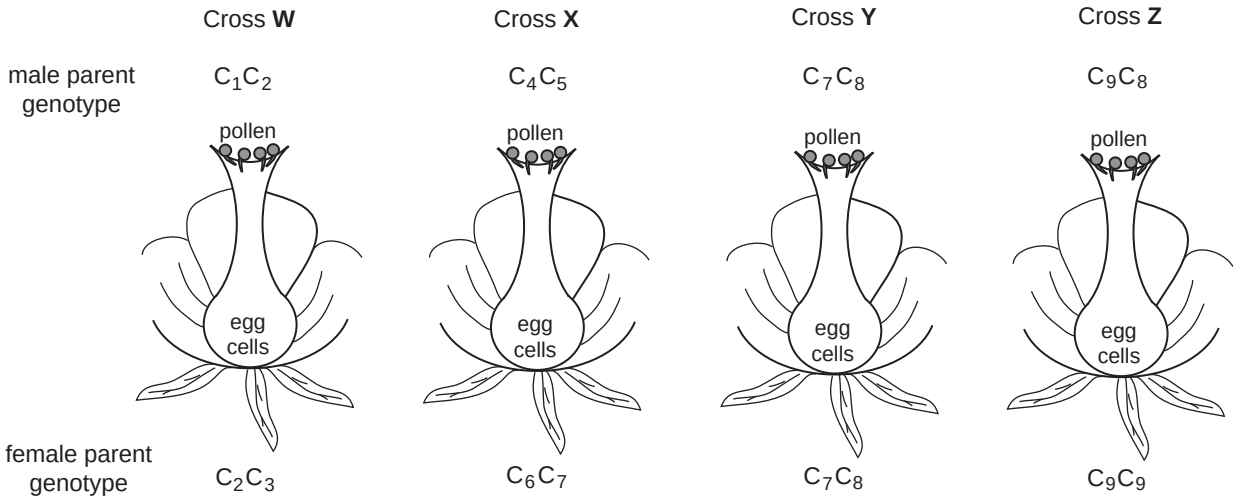
C. the soapberry tree is common throughout the distribution and each tree produces large amounts of fruit.

D. male soapberry bugs new to a region are reproductively active, whereas female bugs need to feed before becoming reproductively active.

Question 21

A number of different alleles have been discovered at the 'C' locus in white clover plants. These plants prevent self-fertilisation by allele incompatibility. A female gamete produced within a flower will not be fertilised by any male gamete that carries the same allele. For example, a plant with the genotype C_1C_1 producing female gametes will not be fertilised by any pollen containing the allele C_1.

Examine the following diagram.



The cross likely to produce the greatest number of viable seeds is

A. cross W.

B. cross X.

C. cross Y.

D. cross Z.

Question 22

Selective breeding over many generations has produced gradual changes in farm animals.

It is reasonable to state that such gradual changes in a herd of cattle

A. result from random mating in the herd in each generation.

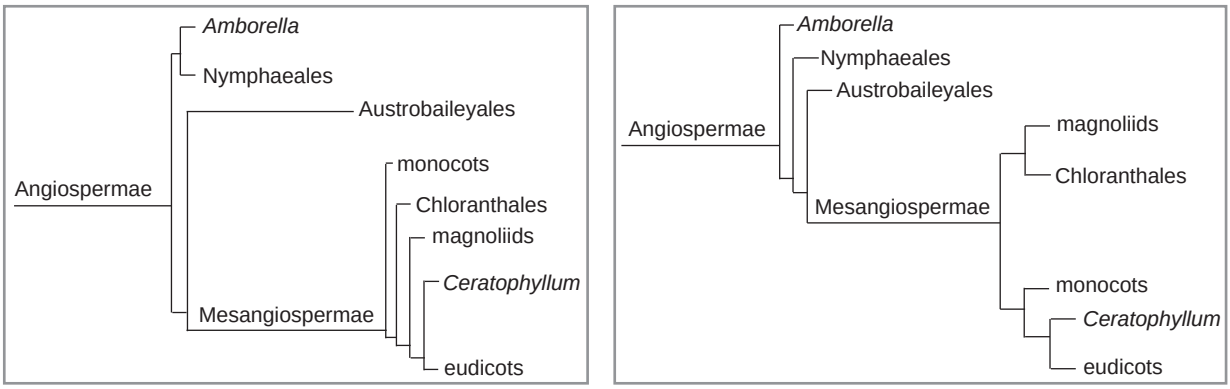
B. are due to the occurrence of gene mutations in each generation.

C. will improve traits that enhance survival of the animals in the wild.

D. result from the restriction of breeding to chosen animals in the herd.

Question 23

Two possible phylogenetic relationships between eight groups of flowering plants are shown in the following diagrams.



One similarity between the alternatives is

A. monocots diverged before Chloranthales.

B. *Ceratophyllum* and eudicots diverged from monocots.

C. *Amborella* and Nymphaeales diverged first from Angiospermae.

D. magnoliids were the first group to diverge from Mesangiospermae.

Question 24

The first step of gene expression is

A. translation of DNA.

B. transcription of DNA.

C. modification of RNA.

D. packaging of proteins.

Question 25

Consider the following hominin (previously called hominid) species.

M *Homo erectus*

N *Homo neanderthalensis*

O *Australopithecus africanus*

P *Australopithecus afarensis*

The order of oldest to youngest hominin species is

A. M N O P.

B. P O M N.

C. N O P M.

D. O M P N.

END OF SECTION A

CONTINUES OVER PAGE

SECTION B – Short answer questions

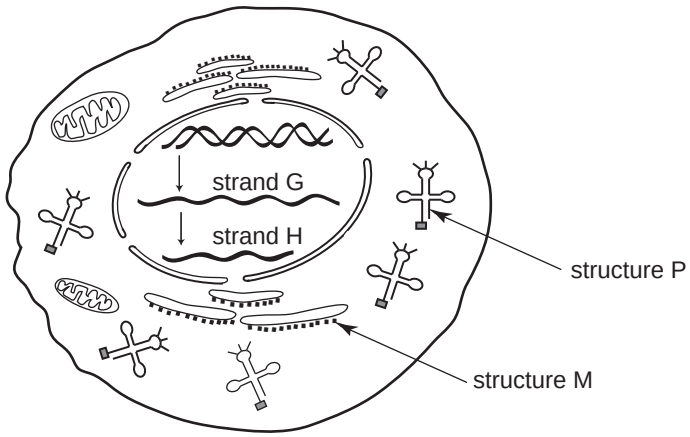
Instructions for Section B

Answer this section in pen.

Answer **all** questions in the spaces provided.

Question 1

Consider the following diagram of a cell. The parts of the diagram are not drawn to scale.



a. In which structure would RNA polymerase be found?

1 mark

b. Describe the function of RNA polymerase.

2 marks

c. Strand H is shorter than strand G. Describe the process that results in this shortening, using appropriate names for both strands.

2 marks

d. Name strand H and structures P and M. Explain how each contributes to protein synthesis.

Strand H _____

_____

_____

Structure P _____

_____

_____

Structure M _____

_____

_____

3 marks

Total 8 marks

Question 2

In a particular plant species, an autosomal gene controls flower colour, with yellow flower colour being dominant to blue.

a. **i.** Assign relevant symbols to the alternative traits.

Allele symbols: Yellow flower _____

Blue flower _____

A test cross was carried out using a heterozygous yellow flower and a blue flower.

ii. Indicate the genotypes of the parents in the test cross.

_____

iii. Show the expected genotype(s) and phenotype(s) of the offspring.

_____

_____

_____

1 + 1 + 1 = 3 marks

b. Outline how a test cross might be used to identify whether a yellow flower plant is homozygous or heterozygous.

_____

_____

_____

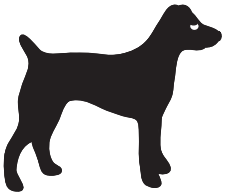
_____

1 mark

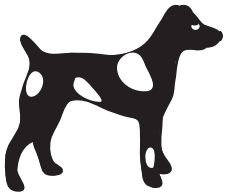
In dogs, two gene loci on different autosomes have the following alleles.

Gene 1	**B**	:	black coat colour	Gene 2	**T**	:	no white on coat
	b	:	grey coat colour		**t**	:	white areas on coat

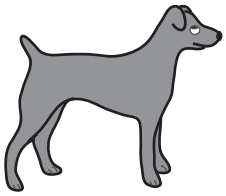
Two dogs, dog **F** and dog **G**, were mated. The litter of four pups that resulted had the following phenotypes.



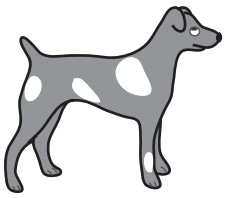
phenotype **M**



phenotype **P**



phenotype **R**



phenotype **S**

c. **i.** What is the genotype of pup **S**?

_____

ii. Explain whether all pups with phenotype **P** would have the same genotype.

_____

_____

_____

iii. What are the genotypes of the parent dogs?

Dog **F**

_____

Dog **G**

_____

1 + 1 + 1 = 3 marks

Total 7 marks

Question 3

In a species of mammal, two inherited phenotypes exist – spiky hair and smooth hair. A scientist set out to produce a clone of a spiky-haired male (organism **M**).

a. i. Which living cell from male **M** would provide the nucleus to start this procedure – one of its somatic cells or one of its sperm cells?

_____

ii. Explain your answer.

_____

_____

_____

1 + 1 = 2 marks

The nucleus chosen was placed into an egg taken from a smooth-haired female mammal of this species (organism **P**).

b. i. What procedure must this egg undergo before the nucleus from organism **M** is added?

_____

_____

ii. Explain why this procedure must occur.

_____

_____

_____

_____

_____

1 + 2 = 3 marks

This egg cell, with its transplanted nucleus, was placed in the uterus of a smooth-haired mammal (organism **R**) to complete development.

c. Which of the three organisms – **M**, **P** or **R** – will the cloned organism most closely resemble in terms of all other traits?

_____

1 mark

Total 6 marks

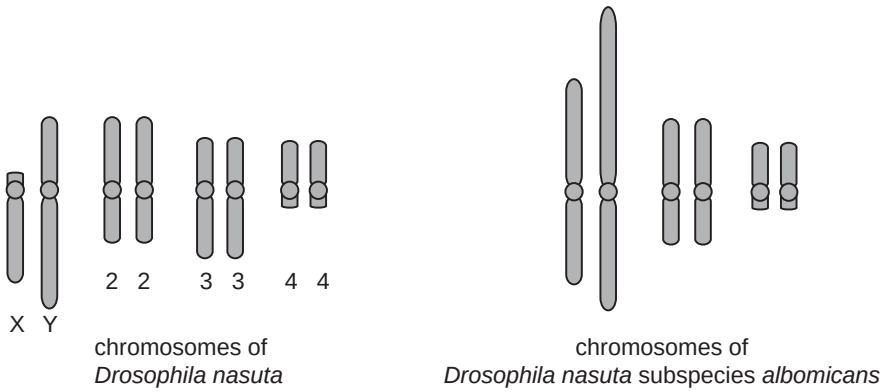
Question 4

Species of the fruit fly *Drosophila* generally have four pairs of homologous chromosomes.

a. What is meant by the term 'homologous chromosomes'?

1 mark

The number of chromosomes sometimes varies from the usual four pairs. Karyotypes of two different *Drosophila* are shown in the following diagram. Note that one is a subspecies of the other.



b. Describe an event that could have caused the chromosome differences between *D. nasuta* and *D. nasuta* subspecies *albomicans*.

1 mark

A cross between a female *D. nasuta* and a male *D. nasuta* subspecies *albomicans* results in offspring.

c. What would be the diploid number of these hybrid flies?

1 mark

d. Explain how chromosome differences between *Drosophila nasuta* and *Drosophila nasuta* subspecies *albomicans* could result in their reproductive isolation and speciation.

2 marks

Total 5 marks

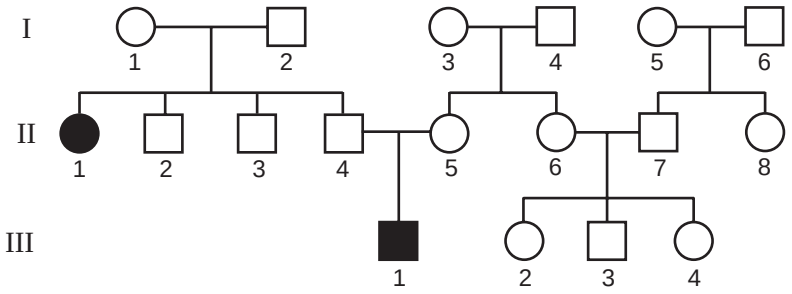
Question 5

The quarter horse, as a breed, originated by selective breeding. The first Australian quarter horses were imported from North America in the 1950s. A genetic condition called Hereditary Equine Regional Dermal Asthemia (HERDA) affects certain individuals. HERDA horses have a reduced life expectancy. Affected horses have a pedigree that is linked to an American stallion, Polo Bueno, which lived in the 1940s.

a. Which cells in the body of Polo Bueno were affected by the mutation allowing HERDA to be inherited?

1 mark

Examine the following pedigree.



b. What is the mode of inheritance of HERDA?

1 mark

c. After the horses arrived in Australia, mare II5 is mated to a normal stallion from a different family with no family history of HERDA. Using appropriate symbols for genotypes, show all possible outcomes of this mating. Include the phenotypes and genotypes of parents and foals.

2 marks

A young woman, Emma, purchases a quarter horse, called Penny, for breeding. Testing shows that Penny is heterozygous for HERDA as well as another genetic condition, Overo Lethal White Syndrome (OLWS). Any horse homozygous for OLWS dies at birth.

d. Penny is mated to a stallion which is also heterozygous for both conditions.

i. What is the chance that Penny has a foal that dies at birth?

ii. What is the chance that Penny has a foal that is phenotypically normal?

1 + 1 = 2 marks

A DNA sequencing test is available that reveals the HERDA status of a horse. The sequence for the different genes is shown below.

The sequence for a normal gene is	AAG	AAG	AAG	GGG	CCT	AAA.
The sequence for the HERDA gene is	AAG	AAG	AAG	AGG	CCT	AAA.

e. **i.** What is the name given to this type of mutation?

The laboratory must sequence the DNA of a horse to find the difference in the gene rather than use restriction enzymes and gel electrophoresis.

ii. Suggest why the use of restriction enzymes and gel electrophoresis is not possible with the HERDA mutation.

1 + 1 = 2 marks

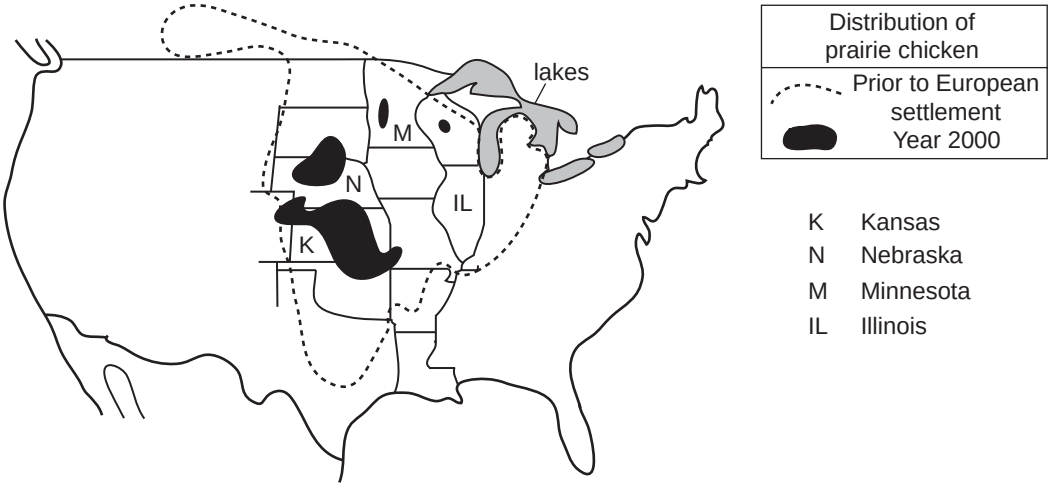
Total 8 marks

Question 6

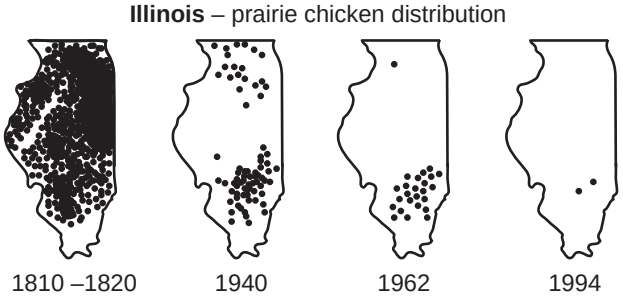
a. Define genetic drift.

1 mark

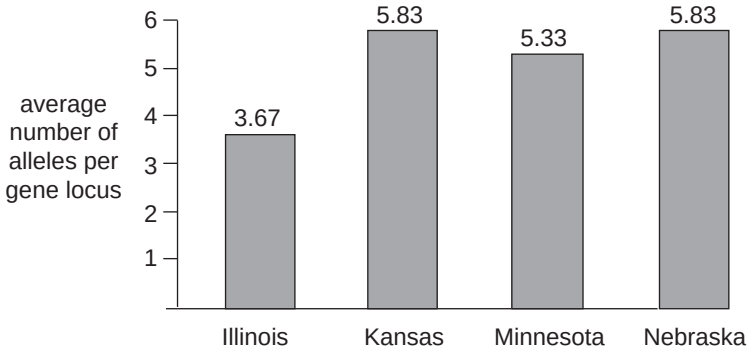
The prairie chicken (*Tympanuchus cupido pinnatus*) is a grassland bird native to North America. A prairie chicken spends its entire life within several kilometres of its birthplace. Prior to European settlement, prairie chickens numbered in the millions across the Midwest of the United States of America. As a result of the grasslands being replaced by plant food crops, the distribution of prairie chickens has diminished, as shown below.



By 1994, Kansas, Nebraska and Minnesota still supported large and widespread populations; however, in the state of Illinois, the number of prairie chickens fell to less than fifty individuals isolated in two separate geographical areas.



Representative samples of prairie chickens from the four states were selected for testing. Each prairie chicken had six gene loci tested. The average number of alleles at each gene locus for each prairie chicken group is shown in the graph below.



b. **i.** Explain the significance of the results for the Illinois birds compared to the results of the birds from the three other states.

ii. Explain why the results for the Kansan birds and Nebraskan birds are similar to each other.

2 + 1 = 3 marks

Measures were taken in the 1990s to prevent the Illinois prairie chicken from dying out completely.

c. **i.** Explain why low genetic diversity in a population threatens the survival of the population.

ii. Describe one measure that could be used to prevent the Illinois prairie chicken from dying out.

2 + 1 = 3 marks

Total 7 marks

Question 7

The Mitochondrial Eve Hypothesis suggests that the mitochondrial DNA of all living people can be traced back to a few women in Africa.

a. **i.** Why is mitochondrial DNA useful for tracking human evolutionary history?

ii. Name another type of DNA that can be used to trace human ancestry.

1 + 1 = 2 marks

It has been observed that

- samples of mitochondrial DNA taken from living humans are very similar to each other
- the greatest variation of mitochondrial DNA is observed within African populations.

b. Based on these observations, what are **two** inferences that can be made about human evolution?

2 marks

c. **i.** Explain why DNA analysis cannot be used to trace very early hominin (previously called hominid) ancestry.

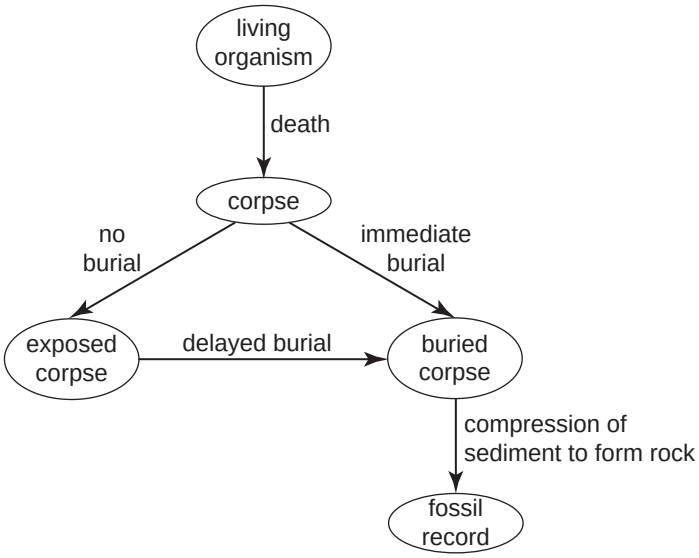
ii. Outline two types of evidence, other than DNA analysis, that can be used to determine the relatedness and age of early hominins.

Evidence 1

Evidence 2

1 + 2 = 3 marks

Two early hominins were fossilised in two different areas of Africa. One hominin was buried quickly during an avalanche while the other was buried slowly on a forest floor. The figure below represents these two different possibilities for fossilisation of the hominins.



d. **i.** Outline one reason why the hominin in the forest would have a greater chance of being only partially fossilised.

_____

_____

ii. State one factor not indicated on the diagram that would increase the chance of fossilisation of an organism.

_____

_____

1 + 1 = 2 marks

Total 9 marks

END OF QUESTION AND ANSWER BOOK