

BIOLOGY Year 12

UNITS 3/4

2016



SHENTON
COLLEGE

Name: _____

Teacher: _____

Time allowed for this paper

Reading time before commencing work: ten minutes

Working time for paper: three hours

Materials required/recommended for this paper

To be provided by the supervisor

This Question/Answer Booklet

Multiple-choice Answer Sheet

To be provided by the candidate

Standard items: pens (blue/black preferred), pencils (including coloured), sharpener, correction fluid/tape, eraser, ruler and highlighters

Special items: non-programmable calculators approved for use in the WACE examinations

Important note to candidates

No other items may be taken into the examination room. It is **your** responsibility to ensure that you do not have unauthorised notes or items of a non-personal nature in the examination room. Any unauthorised material must be handed to the supervisor **before** reading any further.

Structure of this paper

Section	Number of questions available	Number of questions to be answered	Suggested working time (mins)	Marks available	Percentage of exam	% achieved
Section One: Multiple-choice	30	30	40	30	30	
Section Two: Short answer	5	5	90	100	50	
Section Three: Extended answer	4	2	50	40	20	
				Total	100	

Instructions to candidates

- The rules for the conduct of examinations for WACE courses are detailed in the *Year 12 Information Handbook 2016*. Sitting this examination implies to agree to abide by these rules.
- Answer the questions according to the following instructions.

Section One: Answer **all** questions on the separate Multiple-choice Answer Sheet provided. For each question, **shade** the box to indicate your answer. Use only a blue or black pen to shade the boxes. If you make a mistake, place a cross through the square and shade your new answer. Do not erase or use correction fluid/tape. Marks **will not** be deducted for incorrect answers. No marks will be awarded if more than one answer is shaded for any question.

Section Two and Three: Write your answers in the spaces provided in this Question/Answer Booklet. Wherever possible, keep your answers confined to the lines provided. Use a black or blue pen for these sections. Only graphs and diagrams may be drawn in pencil.

Section Three consists of **two parts**, each with **two questions**. You must answer **one question** from **Unit 3** and **one question** from **Unit 4**. Tick the box next to the question you are answering. Do not copy the questions when writing your answer. Questions may be answered in a number of ways: tables, graphs or diagrams clearly labelled and explained, dot points with linking sentences and drawing annotated flow diagrams with introductory notes.

- You must be careful to confine your responses to the specific questions asked and follow any instructions specific to that particular question.
- Spare pages are included at the end of **this** booklet. They can be used for planning your responses and/or as additional space if required to continue an answer.
Planning: If you use the extra pages for planning, clearly indicate this at the **top** of the page.
Continuing an answer: If you need the extra pages to continue an answer, indicate in the **original** answer space where you continued the answer (i.e. page number). Write the question number you are continuing at the top of the spare page.

Section One: Multiple-choice**30% (30 marks)**

This section has **30** questions. Answer **all** questions on the separate Multiple-choice Answer Sheet provided. For each question, shade the box to indicate your answer. Use only a blue or black pen to shade the boxes. If you make a mistake, place a cross through that square, then shade your new answer. Do not erase or use correction fluid/tape. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

Suggested working time: 40 minutes

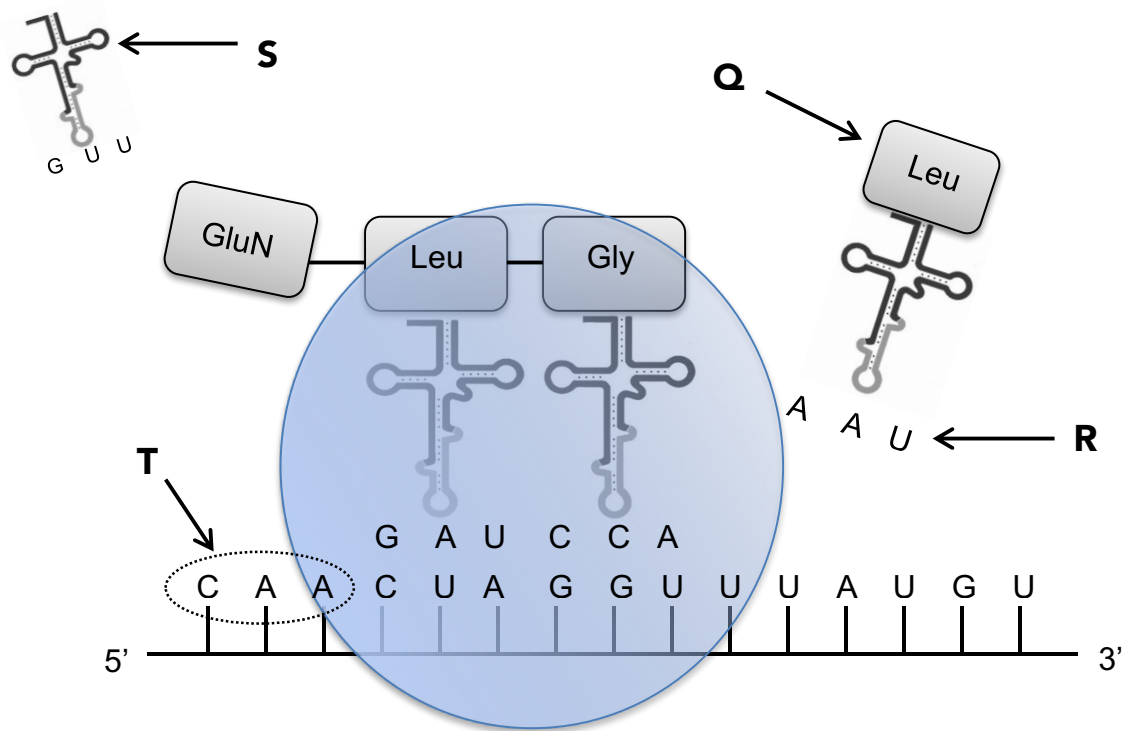
1. Enzymes are specialised proteins that increase the rate of biological reactions by
 - (a) breaking down complex substrates.
 - (b) acting on specific molecules.
 - (c) having a functional active site.
 - (d) lowering the activation energy.

2. Which of the following statements best describes a pathogen?
 - (a) A micro-organism that is able to be transmitted from one organism to the next.
 - (b) An organism that lives within a host, causing disease.
 - (c) A prokaryotic organism that infects eukaryotic organisms by evading their immune system.
 - (d) An agent that causes disease through infection between host organisms.

3. Which of the following homeostatic activities represent negative-feedback mechanisms?
 - (a) Labour, fever and gas-exchange.
 - (b) Water balance, gas-exchange and thermoregulation.
 - (c) Blood-glucose levels, thermoregulation and fever.
 - (d) Fever, lactation and water balance.

4. Malaria is a highly infectious disease caused by a pathogen from the *Plasmodium* genus. Malaria is transmitted through the bite of a female *Anopheles* mosquito. An effective immunisation program to prevent infection with Malaria has not been developed because
 - (a) it has a complex life-cycle that involves both host and vector.
 - (b) it produces a toxin that is unable to be eliminated by vaccine or other pharmaceuticals.
 - (c) the treatments available for infected persons are extremely effective and inexpensive.
 - (d) scientists have been unable to collect the *Plasmodium* pathogen from the host's blood as it is rapidly destroyed by liver cells following infection.

Questions 5 to 7 relate to the diagram below.



5. Which cellular process is represented in this diagram?
- Phosphorylation
 - Transcription
 - Replication
 - Translation
6. What are the structures labelled Q, R, S and T, respectively?
- tRNA, ribosome, codon, anticodon
 - mRNA, DNA polymerase, codon, DNA
 - Amino acid, anticodon, tRNA, codon
 - Nucleotide, codon, mRNA, DNA
7. In which organelle does this process occur?
- Nucleus
 - Ribosome
 - Endoplasmic Reticulum
 - Mitochondria

8. The genetic code provides evidence that all organisms on the planet have a common ancestor. This is because all organisms
- (a) carry the same mitochondrial DNA.
 - (b) past and present, carry the same nitrogenous bases in their DNA that code for the same amino acids.
 - (c) reproduce in the same manner.
 - (d) possess the exact same number of chromosomes and genes as each other.
9. Intraspecific variation refers to the
- (a) phenotypic variation between individuals of the same species.
 - (b) genotypic variation between individuals of the same species.
 - (c) genotypic variation between organisms of different species.
 - (d) phenotypic variation amongst species of the same genus.
10. It has been suggested that the use of transgenic organisms in agriculture may have negative effects on the surrounding native flora and fauna. The most likely reason is that
- (a) it may increase their resistance to disease.
 - (b) the altered genes could be transferred by viral or bacterial vectors to native organisms.
 - (c) native animals may feed on the transgenic crops and become ill.
 - (d) they may become invasive to the surrounding natural ecosystem.
11. Which of the following terms best represents a genotype that can be determined by more than two alleles?
- (a) Polygenic inheritance
 - (b) Polygenic alleles
 - (c) Quantitative alleles
 - (d) Multiple alleles
12. Scientists use a molecular tool to find specific alleles in a person's DNA. This is called a
- (a) genetic sequencer.
 - (b) gene probe.
 - (c) plasmid.
 - (d) restriction enzyme.

13. The Bottleneck effect can be detrimental to the survival of a species because
- (a) recessive alleles are removed from the gene pool creating a phenotypically dominant trait structure within the population.
 - (b) the gene pool is permanently reduced.
 - (c) individuals are no longer able to reproduce successfully with each other causing species extinction.
 - (d) genetic diversity within the population is increased creating more competition for resources amongst individuals.

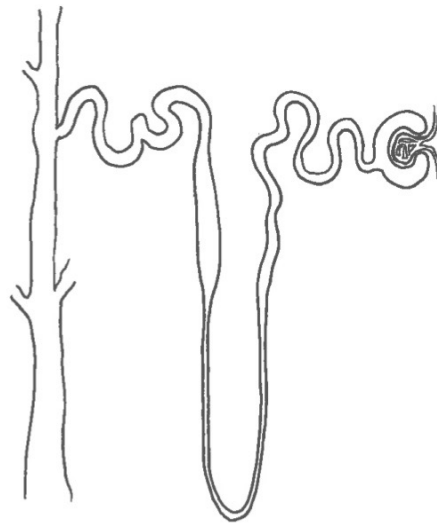
Questions 14 and 15 relate to the information given below.

A scientist was investigating the inheritance of colour in capsicums. She used Mendelian methodology to cross plants with red fruit and plants with purple fruit. She successfully grew capsicums through to the F_2 generation. The data collected revealed that 100% of the plants in the F_1 generation produced red fruit. In the F_2 generation, 75% of the plants had red fruit while the remaining 25% had purple fruit.

14. What can the scientist conclude about the original parent plants from the data collected?
- (a) Red fruit is the dominant trait and the genotype of both parent plants is heterozygous.
 - (b) Purple fruit is the recessive trait and the genotype of the parent plants is homozygous.
 - (c) Purple fruit is the dominant trait and the genotype of both parent plants is homozygous.
 - (d) Red fruit is the recessive trait and the genotype of both parent plants is heterozygous.
15. During the investigation, the scientist noticed that purple fruit had thicker flesh than red fruit. What is the best explanation for this phenomenon?
- (a) Both traits are recessive and transmitted independently of each other.
 - (b) The occurrence of thick flesh in the purple fruit is merely coincidental and more research should be undertaken before a solid conclusion can be made.
 - (c) The inheritance of purple fruit and thick flesh is an example of a monohybrid cross from independent assortment of alleles.
 - (d) The inheritance of purple fruit and thick flesh is an example of a dihybrid cross with linked alleles.

16. A zoonotic disease is best described as a disease that
- (a) has only been found within the confines of a zoo.
 - (b) requires a host to complete its lifecycle.
 - (c) only affects organisms within Kingdom Animalia.
 - (d) can be transmitted between animals and humans.
17. Different animals maintain their body temperatures in a variety of ways. Which of the following best describes an animal that is an **ectotherm**?
- (a) An emu living in the Simpson Desert.
 - (b) A tuna that can dive to great depths.
 - (c) A polar bear hibernating over the winter months.
 - (d) A green tree frog living in a temperate forest.

The following diagram represents a nephron from a human kidney.



18. Which of the following statements correctly describes how the nephron of a desert marsupial is different?
- (a) The loop of Henle is very long to increase the reabsorption of water.
 - (b) The glomerulus is smaller to decrease the amount of fluid entering the Bowman's capsule.
 - (c) The loop of Henle is much shorter to stop sodium and urea from being lost in the urine.
 - (d) The distal convoluted tubule is reduced in order reduce amount of water reabsorbed.

Questions 19 to 21 relate to the information below.

Genetic scientists discovered a new variant to an otherwise harmless plant virus. This new variant is the result of exposure to an enzyme produced by the virus itself. Infected plants have misshapen stomata, which prevents the pores from opening properly. The scientists concluded that when mRNA is being transcribed along the affected gene, **adenine** is being read as **cytosine**.

19. What type of mutation does this virus variant cause?
- (a) Frameshift mutation
 - (b) Missense mutation
 - (c) Nonsense mutation
 - (d) Substitution mutation

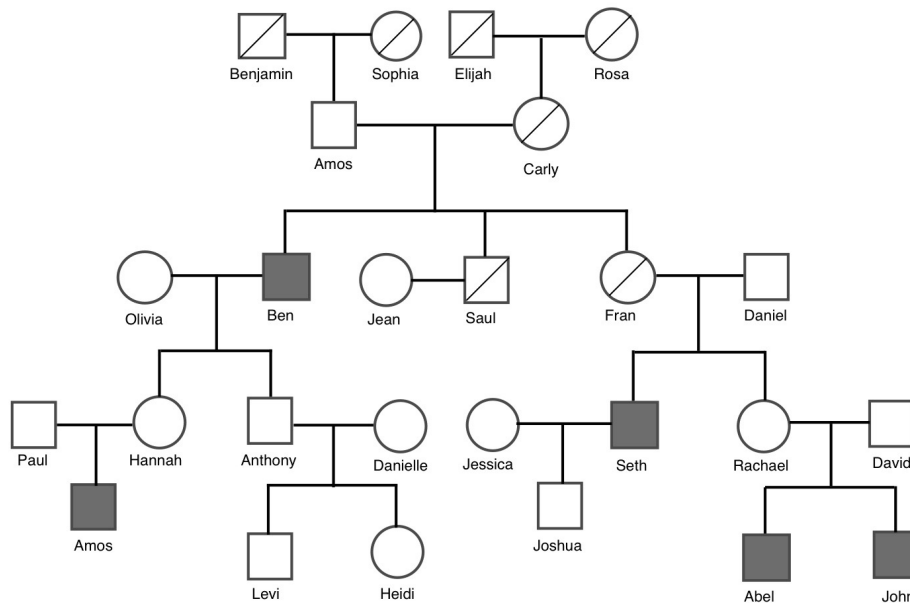
The original DNA template strand for a section of the variant gene is shown below.

AAC TGA TTC CGC CAT

20. What would the resultant mRNA molecule read for the mutated gene?
- (a) UUU ACU AAG GCG GUA
 - (b) GGG ACG AAG GCG GGA
 - (c) UUG AAU AAG GAG GUA
 - (d) CCG ACC AAG GCG GCA
21. What would be the most direct effect of misshapen stomata to an infected plant?
- (a) Photosynthesis would not occur properly, stunting plant growth.
 - (b) Energy would not be released to fuel metabolic activities.
 - (c) Transpiration would be reduced resulting in flaccid leaf cells.
 - (d) Xylem cells would lose their structural integrity causing the plant to wilt.
22. The mosquito borne Zika virus has rapidly spread throughout South America, causing severe illness and malformation of unborn babies. Which of the following control measures should be used to reduce the connection between the source of infection and susceptible individuals?
- (a) Quarantine infected individuals and carriers of the disease.
 - (b) Destroy the animal reservoir of infection.
 - (c) Treat sewage to reduce the spread of disease through contaminated water.
 - (d) Destroy vectors through widespread spraying of insecticides.

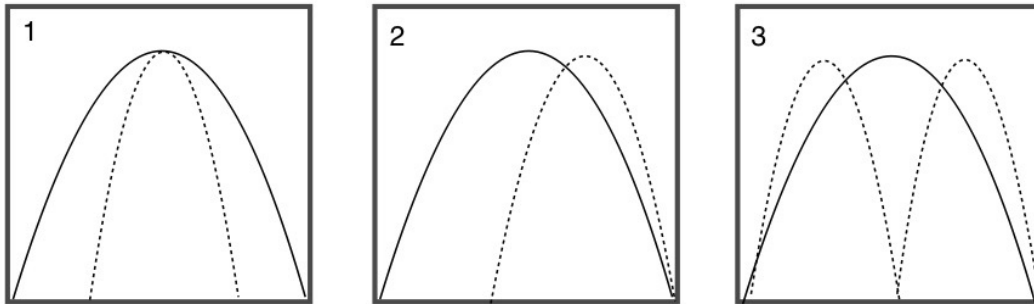
Questions 23 and 24 refer to the information and diagram below.

The Schumann family has been in Australia for three generations. The great grandfather Amos and his father immigrated to Australia from Poland in 1947. In every generation of Schumanns born from this time, at least one member has inherited a genetic disease. As they have no family records before 1947, the origin of the disease cannot be easily identified. Amos attempted to construct a pedigree chart with all members of his family. *Individuals known to be affected are shaded grey. Deceased family members have a line through them.*



23. What type of inheritance pattern does this pedigree reveal?
- Autosomal recessive
 - X-linked dominant
 - Autosomal dominant
 - X-linked recessive
24. Amos was devastated when the son of his favourite grandchild, also named Amos, was born with the disease. He became convinced that he was responsible for bringing the disease into the family through his ancestors. His son Benjamin researched inherited diseases and concluded that his father was incorrect; the disease must have been passed down from his mother's side. The main reason for his conclusion is that
- the disease can be inherited from unaffected parents with a heterozygous genotype.
 - all daughters of the affected males must inherit the disease.
 - each affected person must have at least one affected parent.
 - affected males cannot pass on the disease to their male offspring.

Natural selection favours phenotypes that are most successful in their environment. There are three main types of natural selection that are shown in the graphs below.



25. Which graph best represents a population that could lead to the formation of a new species?
- (a) 1
 (b) 2
 (c) 3
 (d) Both 2 and 3
26. When an enzyme becomes denatured it can no longer act as a biological catalyst. This is because
- (a) the tertiary structure unravels when the bonds are broken.
 (b) the peptide bonds are broken releasing amino acids into the cytosol.
 (c) the protein dissolves.
 (d) it can no longer react with specific molecules.
27. Australia's quarantine measures for international trade are more effective than some other countries around the world. This is most likely attributed to Australia's
- (a) strict screening of imported produce for pests and disease.
 (b) geographical isolation.
 (c) restriction on international travel of diseased persons.
 (d) use of isolation methods for diseased individuals entering the country.

28. In order to maintain water balance and reduce energy consumption, reptiles excrete nitrogenous waste in the form of
- (a) ammonia.
 - (b) urine.
 - (c) guano.
 - (d) uric acid.
29. The Amphibian Chytrid Fungus Disease has caused the decline and even extinction of many frog species in Australia. The Chytrid fungus can cause death in amphibians because it
- (a) infects a frog's snout and mouth, making it difficult to breathe.
 - (b) infects the surface skin layers causing problems with water balance and respiration.
 - (c) invades a frog's lungs, reducing the surface area for the diffusion of gases.
 - (d) causes the over-production of keratin in skin cells, preventing oxygen from permeating into the bloodstream.
30. Common ancestry within Phylum Chordata can be revealed during the embryonic stage with the development of numerous structures, including
- (a) webbed phalanges.
 - (b) pharyngeal slits.
 - (c) vertebrae.
 - (d) eye spots.

End of Section One

Section Two - Short answer**50% (100 marks)**

This section has **five (5)** questions. Answer **all** questions. Write your answers in the spaces provided.

Spare pages are included at the end of this booklet. They can be used for planning your responses and/or as additional space if required to continue an answer.

- Planning: If you use the spare pages for planning, indicate this clearly at the top of the page.
- Continuing an answer: If you need to use the space to continue an answer, indicate in the original answer space where the answer is continued, i.e. give the page number. Fill in the number of the question(s) that you are continuing to answer at the top of the page.

Suggested working time: 90 minutes.

Question 31**(20 marks)**

Negative-feedback mechanisms respond to changes in an animal's internal or external environment to maintain homeostasis. Plants, however, do not contain nervous or endocrine systems to help regulate their internal environment. They must possess specialised adaptations to enable them to survive environmental extremes.

- (a) What is the term used to describe plants that are adapted to arid conditions? (1 mark)

- (b) Identify **two** different adaptations for water-balance in this plant group and explain how these adaptations enable their survival. (4 marks)

- (c) It has been suggested that increased CO₂ levels will significantly improve the growth of all plant life by stimulating metabolism. Explain the accuracy of this theory based on your understanding of gas-exchange mechanisms in Australian plants. (3 marks)

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- (d) Suggest how this theory could be tested experimentally. (2 marks)

Approximately 1.6 million years ago, Australia was undergoing a period of drying and lush forests retreated to the periphery of the continent. Species that adapted to the changing climate may have phylogenetic links to the flora currently inhabiting Australia's arid environments.

- (e) Which biotechnological process could be used to establish the genetic relationship between an extinct well preserved specimen and a living plant species? (1 mark)

- (f) Outline the main steps in this process. (6 marks)

- (g) Explain how the genetic relatedness between two different species is measured using the results from this process. (3 marks)

Question 32**(20 marks)**

The way in which pathogens are transmitted from one host to another can significantly impact how easily it can spread.

- (a) Identify **two** human behaviours that can reduce the risk of contracting or spreading a contagious disease. (2 marks)

- (b) Explain why a pathogen, showing latent infection, can have a high degree of infectivity. (2 marks)

- (c) Differentiate between the terms endemic, epidemic and pandemic. (3 marks)

The development of vaccines has enabled highly contagious diseases to be eradicated from the global population.

- (d) Describe how immunisation programs have been successful in stopping the spread of virulent pathogens. (2 marks)

- (e) Explain the concept of 'herd immunity'. (2 marks)

- (f) Explain why herd immunity has been compromised in some communities around Australia. (2 marks)

Bacteria are the most abundant and diverse group of organisms on the planet. Much of their success can be attributed to adaptations and transmission.

- (g) Identify **two** adaptive characteristics of bacteria and explain how these characteristics increase a bacteria's chance of survival. (4 marks)

- (h) Outline **three** different ways in which bacteria cause disease. (3 marks)

Question 33**(20 marks)**

A horse breeder sold a healthy young colt to a well-known trainer and jockey for a large sum of money. The colt was the offspring of a Melbourne Cup winner. The trainer received the appropriate paternity papers when the colt was delivered. The trainer was also told that the colt had three siblings fathered by the same horse.

Two months later, the trainer received information that the horse breeder was under investigation for selling horses under false pretences. The paternity of one the colt's 'siblings' was under investigation. Unfortunately, the champion horse had been shipped overseas for a race and blood samples could not be taken.

- (a) Identify **two** types of biological material, other than blood, that could be used to access the father's DNA. (2 marks)

An insufficient amount of DNA was obtained from the alleged father, and a genetic profile could not be produced in order to compare his DNA with the DNA of his alleged offspring.

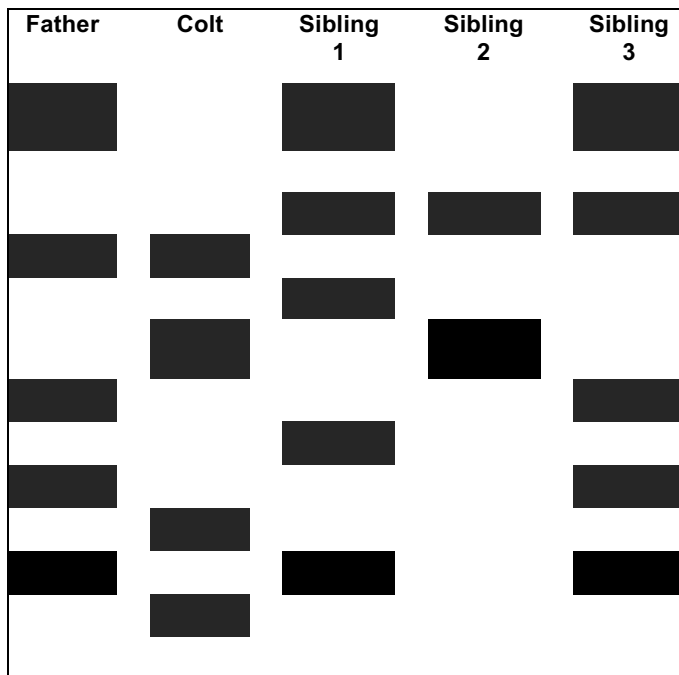
- (b) Explain how geneticists overcome issues associated with small DNA samples. (2 marks)

- (c) Geneticists use areas within the DNA called **short tandem repeats** (STR's) or **microsatellites** to produce DNA profiles. Define the term **short tandem repeats** and discuss why STR's are useful in this type of research. (5 marks)

Genetic samples were obtained and processed for each horse. To establish the genetic relatedness of the horses, the geneticist used gel electrophoresis to visualise the DNA.

- (d) Outline the process of gel electrophoresis as a method for DNA profiling. (6 marks)

The diagram below displays the comparative DNA of each horse following the gel electrophoresis process.



- (e) Identify the order of relatedness, from most to least related, of each horse to the alleged father. (2 marks)

(f) Explain why the horse breeder is guilty of genetic fraud. (3 marks)

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Question 34**(20 marks)**

Research scientists, growing new 'skin' for burn victims, discovered a protein that they believe accelerates cell division and growth. The gene that codes for this protein was found in a strain of smallpox previously eradicated from our population. The protein is only effective if the virus gene is integrated into the DNA of the growing skin cells.

- (a) Suggest **one** reason why research scientists may have difficulty obtaining ethical permission to carry out trials on humans using these genetically modified cells. (1 mark)

- (b) Suggest **one** possible, positive outcome of this research process. (1 mark)

In order to gain permission from the ethics committee, the researchers had to carry out a series of stringent experiments to prove the effectiveness of the protein on skin cell growth. Three different 'types' of human skin cells were used in the experiment; skin stem cells, newly differentiated skin cells and mature skin cells. Fifty cell-growth containers, each holding 200mL of nutrient medium, were inoculated with 100 genetically modified cells from each type being tested. The cells were cultured in a temperature-controlled room at 37°C for 20 days. Every two days, the number of live cells present on each agar plate was recorded.

- (c) Write a hypothesis for this experiment. (1 mark)

- (d) State the independent and dependent variables of this experiment. (2 marks)

Dependent _____

Independent _____

- (e) State **two** variables that were controlled in the experiment. (2 marks)

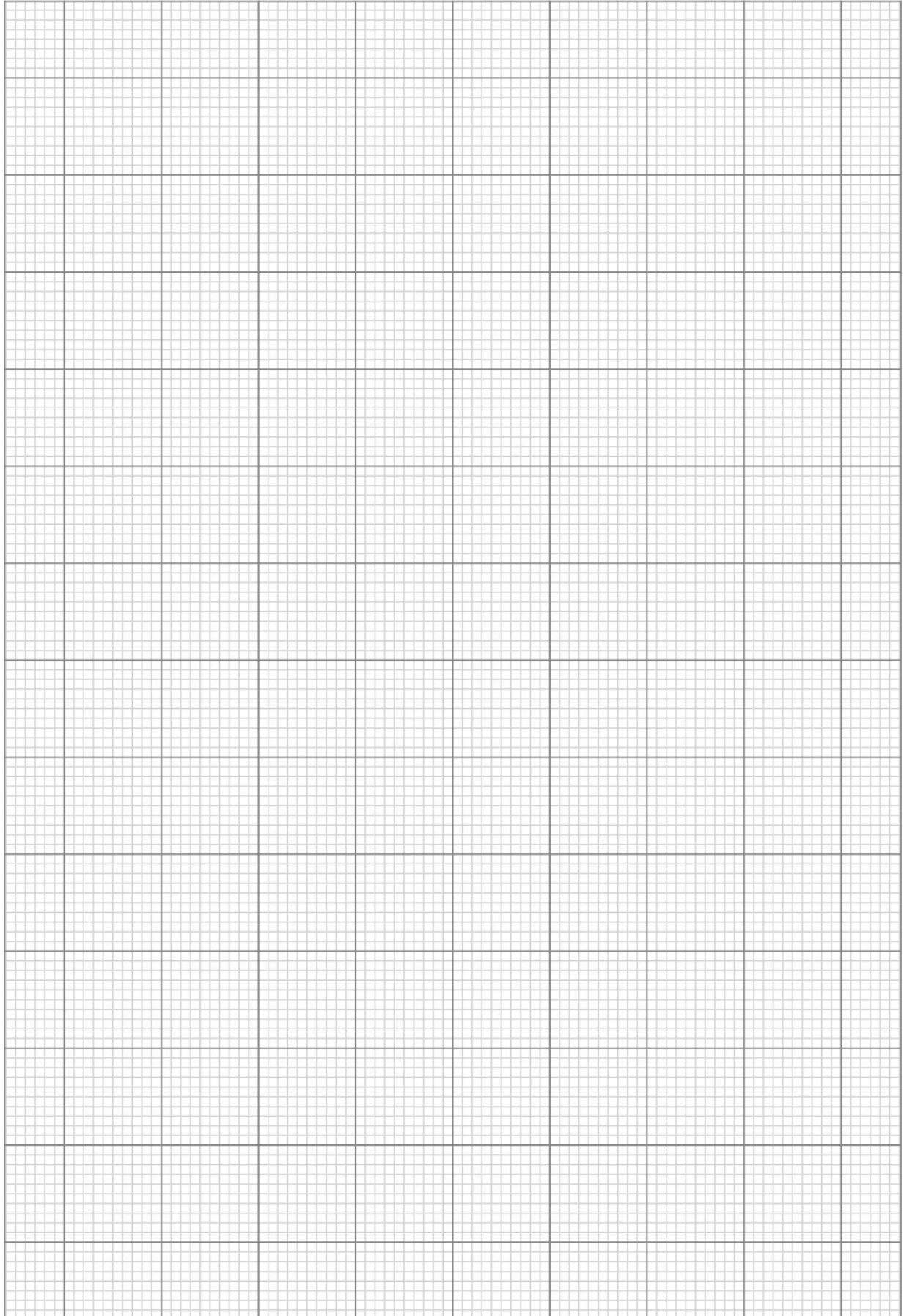
The scientists calculated the mean values for the data they collected over the 20-day period. This is presented in the table below.

Table 1 – Mean cell numbers of genetically modified skin cells over a 20-day period.

Day **Mean number of cells**

	Stem	Newly differentiated	Mature
0	100	100	100
2	350	600	150
4	1000	1300	280
6	2500	6100	440
8	6000	10000	630
10	8500	15300	750
12	12400	21200	790
14	14100	23200	920
16	17500	23800	1140
18	19300	24100	1340
20	22800	24500	1480

- (f) Construct a graph in the space provided to display the data in Table 1. (6 marks)



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- (g) What can you conclude from the data presented in your graph? (3 marks)

The ethics committee was presented with a report from the skin cell experiment. To their horror, the researchers were not given permission to proceed with their human trials because the committee decided that their data was invalid. They would have to start their research over with an improved experimental design.

- (h) Identify **two** errors in the experimental design and make suggestions as to how these could be resolved. (4 marks)

Question 35

(20 marks)

Consider the images of Australian animals shown below.

(i)



(ii)



(iii)



(a) Identify an adaptation for each animal that assists thermoregulation and state whether it is structural, physiological or behavioural (or a combination). (3 marks)

(i) _____

(ii) _____

(iii) _____

(b) Describe how these adaptations enable each animal to maintain its core body temperature. (6 marks)

Counter-current heat exchange is a structural and physiological adaptation found in animals that inhabit extremely cold environments.

(c) Draw a labelled diagram representing a counter-current heat exchange loop. (3 marks)

(d) Identify an animal in which this adaptation is found and the location in its body. (2 marks)

(e) Explain the process of counter-current heat exchange. (4 marks)

(f) Outline **two** reasons why this adaptation is so important to the survival of Antarctic or Arctic animals. (2 marks)

End of Section Two

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Section Three – Extended Answer**20 marks (20%)**

This section contains **Unit 3** questions and **Unit 4** question, in two parts. You must answer **two (2)** questions, **one question** from **Unit 3** and **one question** from **Unit 4**. Please place a tick in the box next to the question you are answering. Write your answers in the space provided.

Spare pages are included at the end of this booklet. They can be used for planning your responses and/or as additional space if required to continue an answer.

- Planning: If you use the spare pages for planning, indicate this clearly at the top of the page.
- Continuing an answer: If you need to use more space to continue an answer, indicate in the original answer space where the answer is continued, i.e. give the page number.
- Write the number of the question(s) that you are continuing to answer at the top of the additional space page.

Responses may include clearly labelled diagrams with explanatory notes; lists of points with linking sentences; clearly labelled tables and graphs; and annotated flow diagrams with introductory notes.

Suggested working time: 50 minutes

Unit 3 – Choose either Question 36 or Question 37.

Question 36**(20 marks)**

Sexual reproduction initiated the rapid evolution of millions of new species throughout geographical time.

- (a) Describe how the process of meiosis and fertilisation contributes to variation within a gene pool. (10 marks)
- (b) Explain how a reproductively isolated species can evolve as a result of permanent changes to gamete DNA. (10 marks)

OR

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Unit 4 – Choose either Question 38 or Question 39.**Question 38****(20 marks)**

Water is essential for life. All living organisms must continually regulate their water and solute concentrations. Most organisms have specialised adaptations in order to maintain a constant internal environment and osmotic gradients.

- (a) Describe and compare the mechanisms involved in the regulation of water balance of aquatic osmoregulators and osmoconformers in both freshwater and marine ecosystems. (10 marks)

Agricultural land in Australia has been significantly affected by salinity. Most crops are salt-sensitive and cannot grow in saline soil. Some pastoralists are planting salt-tolerant plants in affected areas to provide feed for their livestock.

- (b) Describe how some specialised plants are adapted to overcome excess salt in their tissues in order to maintain osmotic potential. (10 marks)

OR

Question 39**(20 marks)**

For thousands of years, Malaria has caused the death of millions of people worldwide. The nature of the Malarial pathogen has made the development of effective treatments both difficult and time consuming.

- (a) Describe the structure of the Malarial pathogen and its method of reproduction. Including a simple, labelled diagram to show the reproductive process. (10 marks)
- (b) Explain how Malaria is transmitted to humans. Outline the signs of infection, possible treatments and preventative measures currently used in affected areas. (10 marks)

End of Section Three

