

BIOLOGY

Year 12 ATAR

2017



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 tape/fluid, eraser, ruler, highlighters

Special items: non-programmable calculators approved for use in this examination

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 any unauthorised material. If you have any unauthorised material with you, hand it 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 (minutes)	Marks available	Percentage of exam	Percentage achieved
Section One Multiple-choice	30	30	40	30	30	
Section Two Short answer	5	5	90	100	50	
Section Three Extended answer Unit 3	2	1	50	40	20	
Unit 4	2	1				
				Total	100	

Instructions to candidates

- The rules for the conduct of the Western Australian Certificate of Education ATAR course examinations are detailed in the Year 12 Information Handbook 2017. Sitting this examination implies that you agree to abide by these rules.

- Answer the questions according to the following instructions.

Section One: Answer all questions on the 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.

Section Two: Write your answers in the spaces provided in this Question/Answer booklet. Wherever possible, confine your answers to the line spaces provided.

Section Three: Consists of two parts each with two questions. You must answer one question from each part. Tick the box next to the question you are answering.

- You must be careful to confine your responses to the specific questions asked and to follow any instructions that are specific to a particular question.
- Additional working space pages at the end of this Question/Answer booklet are for planning or continuing an answer. If you use these pages, indicate at the original answer, the page number it is planned/continued on and write the question number being planned/continued on the addition working space 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. Which of the following statements regarding genetic mutation is correct?
 - (a) Somatic cell mutation will carry through to the organism's offspring
 - (b) Germ-line mutations will affect every cell in the offspring's body
 - (c) Germ-line mutation and somatic cell mutation occurs during the anaphase stage of mitosis
 - (d) Organisms with germ-line mutations cannot reproduce effectively

2. Antibiotics are ineffective at treating viral infections because
 - (a) viruses do not contain genetic material and invade healthy cells to avoid chemical detection from antibiotics.
 - (b) viruses mutate too quickly for antibiotics to be effective.
 - (c) antibiotics target cellular processes that occur within cellular structures not present in viruses.
 - (d) viruses can only be controlled by vaccination.

3. Microsatellites (or Short Tandem Repeats) have been widely used in the Human Genome Project to show variation in the DNA between individuals. Microsatellites are more effective than 'coding' genes in determining genetic variation because
 - (a) large quantities of microsatellites can be produced by PCR making analysis of variation more accurate.
 - (b) the nucleotide sequences in STR's are smaller and can be separated by gel electrophoresis more readily to reveal differences.
 - (c) 'coding' genes are too similar in genetic composition between individuals of the human race.
 - (d) microsatellites occur in different combinations and have their own genetic profile.

Question 4 relates to the information below.

The Western Swamp Tortoise (*Pseudemydura umbrina*) is the most endangered reptile in the world and lives in a very restricted habitat located northeast of Perth, WA. There are only two populations of the tortoise remaining, comprised of less than 200 individuals.

4. If the environmental conditions were to change, and numbers suddenly and dramatically increased, these populations of the Western Swamp Tortoise would likely exhibit the effects of which evolutionary mechanism?
 - (a) The founder effect
 - (b) Speciation
 - (c) Random genetic drift
 - (d) Bottleneck effect

See next page

5. Which of the following statements referring to linked genes (found on the same chromosome) is **incorrect**?

They are;

- (a) found closely located on the same chromosome.
 - (b) independently assorted during meiosis.
 - (c) more likely to be present in the same gamete.
 - (d) inherited together more than 50% of the time.
6. DNA polymerase is responsible for
- (a) copying DNA sequences using the template strand.
 - (b) transcribing DNA into mRNA.
 - (c) repairing breakages to DNA during the replication process.
 - (d) connecting Okazaki fragments for the lagging strand during DNA replication.
7. Consider the DNA sequences below.

Original strand

5' GCT AAC GUU GAA CCT UGG 3'

Mutated strand

5' GCT AAA GUU GAA CCT UGG 3'

What is the term given to the mutation shown in the mutated strand?

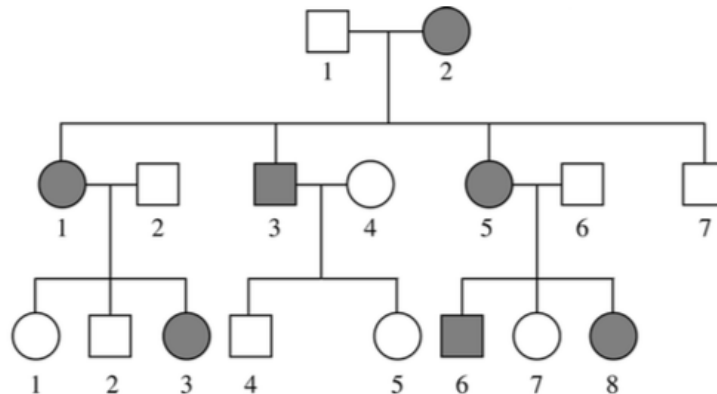
- (a) Insertion
 - (b) Missense
 - (c) Frameshift
 - (d) Nonsense
8. Why is an ectotherm likely to survive longer without access to food than an endotherm of equal size?
- (a) The ectotherm can metabolise its stored energy more efficiently
 - (b) The ectotherm expends more energy than the endotherm
 - (c) The ectotherm has a lower metabolic rate
 - (d) The ectotherm uses more energy to regulate its temperature
9. *Phytophthora cinnamomi* is an introduced plant pathogen that has the potential to destroy whole plant communities. The impact of this particular disease can be difficult to detect in its early stages of infection. This is because *P. cinnamomi*
- (a) infects the roots of susceptible plants causing them to 'rot'.
 - (b) has no measurable symptoms until the plant is dying.
 - (c) has a similar effect on the plant as reduced water availability.
 - (d) spreads too rapidly throughout an ecosystem so all infected species respond in a similar manner.

Question 10 relates to the information below.

A small desert marsupial is exposed to the hot morning sun while it returns to the safety of its burrow. Sensory receptors detect an increase in body temperature. This information is processed through the thermoregulatory centre in the hypothalamus and the appropriate nervous response is produced. The internal temperature of this small marsupial is maintained within an optimum range.

10. The maintenance of body temperature in the marsupial was affected by a
- (a) physiological response.
 - (b) negative feedback mechanism.
 - (c) stimulus-response mechanism.
 - (d) positive feedback mechanism.
11. A response to cold environmental temperatures in endothermic animals is likely to include
- (a) sweating, vasoconstriction of capillaries and decrease in metabolism.
 - (b) shivering, vasodilation of capillaries and increased metabolism.
 - (c) shivering, vasoconstriction of capillaries and erection of hairs.
 - (d) sweating, reduced metabolism and erection of hairs.
12. The PCR (Polymerase Chain Reaction) process begins by targeting the specific sequence of DNA required for amplification. This is carried out by
- (a) DNA polymerase.
 - (b) DNA primers.
 - (c) restriction enzymes.
 - (d) DNA ligase.
13. Conservation biologists aim to protect the genetic diversity of threatened and endangered populations of organisms. This is vital to their future success because:
- a) it allows for adaptability to environmental changes.
 - b) it improves the breeding stock.
 - c) it helps maintain genetic compatibility between individuals.
 - d) it stabilises allele frequency.
14. Which of the following statements regarding artificial selection (selective breeding) is **incorrect**?
- (a) Artificial selection cannot eliminate genetic diseases or unwanted traits from the gene pool
 - (b) Artificial selection reduces the rate of spontaneous mutation in the gene pool
 - (c) Genetic diversity may be reduced in the gene pool as a result of artificial selection
 - (d) Artificial selection acts directly on preferred phenotypes in a population

Question 15 relates to the pedigree below, which shows the inheritance of a rare genetic disease over three generations.

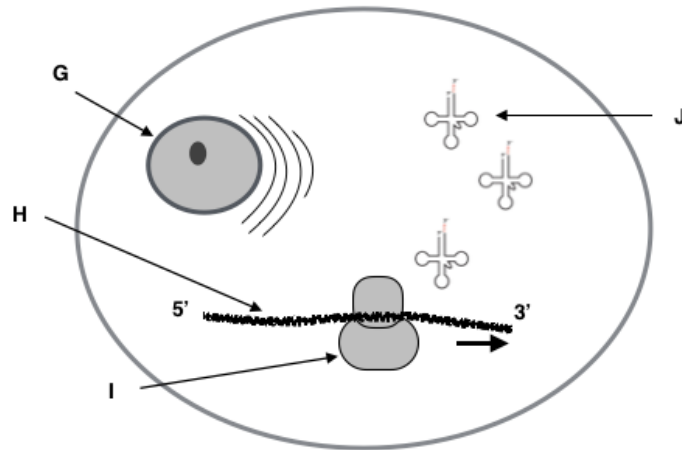


15. What is the most likely mode of inheritance for this disease?
- X-linked recessive
 - Autosomal dominant
 - Y-linked recessive
 - Germ-line mutation
16. The internal environment of marine vertebrates, such as bony fish, is hypotonic to the surrounding water. This means that their internal solute concentration
- is the same as their surroundings.
 - is greater than their surroundings.
 - is lower than their surroundings.
 - changes with their surroundings.
17. Which of the following statements regarding thermoregulation in mammals is **correct**?
- Vasodilation of skin arterioles decreases heat loss
 - Shivering is a nervous response resulting in a decrease in core temperature
 - Exposure to hot, moist air will impede the production of sweat
 - Thermoregulation is controlled by the nervous and endocrine systems
18. The prevention of illness from infection by a pathogenic protist has shown to be largely ineffective. This is mainly due to the protists'
- method of reproduction.
 - mode of transmission.
 - zoonotic capacity.
 - all of the above.

19. Halophytes are found in abundance in arid environments, salt flats and lakes and estuarine ecosystems. Halophytes possess many specialised adaptations to help them survive and flourish, despite harsh conditions. Which of the following adaptations is **unlikely** to be present in a halophyte?
- (a) Waxy cuticle
 - (b) Salt bladders
 - (c) Sunken stomata
 - (d) Abundant stomata
20. Most pathogenic bacteria cause symptoms of illness as a result of
- (a) the production of toxins.
 - (b) immune system disruption.
 - (c) rapid reproduction.
 - (d) cell damage.
21. Communicable diseases are transmitted via several methods. Which of the following is **not** an example of direct transmission of a communicable disease?
- (a) Sexual intercourse
 - (b) Placental blood
 - (c) Kissing
 - (d) Consumption of contaminated food
22. Which of the following statements most accurately describes the relationship between the nucleotide sequences of the template strand and non-template strand in DNA?
- (a) They are identical to each other
 - (b) They are complementary to each other
 - (c) They are held together by hydrogen bonds
 - (d) U is substituted for T in the non-template strand
23. Ross River Virus is a mosquito-borne disease that affects around 5000 Australians each year. Researchers predict that infection rates will increase with changes in climate. To avoid infection with this debilitating virus, health departments encourage people to
- (a) remove any objects from the garden that allow ponding of water.
 - (b) convert chlorinated swimming pools to salt water pools.
 - (c) use insect repellent only at night.
 - (d) keep windows and doors open to allow fresh air to flow through your house.
24. Cartilaginous fish, such as sharks and rays, are osmoconformers: their body fluids are isotonic with the surrounding marine environment. This is possible because cartilaginous fish
- (a) excrete large amounts of urea, thereby reducing osmolarity.
 - (b) drink large amounts of water and excrete concentrated urine to keep a low osmolarity.
 - (c) concentrate urea in their body fluids to maintain a high osmolarity.
 - (d) drink very little water and excrete concentrated urine to decrease osmolarity.

25. Populations change gradually over time in response to changes in their gene pool. This phenomena is known as
- (a) adaptive evolution.
 - (b) genetic drift.
 - (c) macroevolution.
 - (d) microevolution.

Questions 26 and 27 relate to the diagram below.



26. The structure labelled J is
- (a) mRNA.
 - (b) an amino acid.
 - (c) DNA.
 - (d) tRNA.
27. If part of the original DNA sequence reads TTG, the corresponding code on the structure labelled J would be
- (a) UUG.
 - (b) AAC.
 - (c) UUC.
 - (d) TTG.
28. Fossils that resemble modern marine animals have been found within rocks of inland hills and mountains. How can this be explained?
- (a) Marine organisms have evolved from terrestrial organisms
 - (b) Marine organisms possess adaptations that allow them to survive on land
 - (c) The rocks containing the fossils were formed under the ocean
 - (d) Mountains are only formed from fault lines under the ocean floor

29. Which of the following statements most accurately describes the effect of natural selection on a gene pool?
- (a) Natural selection is the result of random changes in the nucleotide sequence of DNA
 - (b) Natural selection supports the inheritance of recessive alleles allowing homozygous genotypes to persist
 - (c) Natural selection works directly on the expression of phenotypes
 - (d) Natural selection increases the rate of mutation in a gene pool
30. On attaching itself to a host cell, a virus
- (a) incorporates its nucleic acid into the cell and makes copies of itself.
 - (b) denatures proteins within the cell membrane.
 - (c) replicates its genetic material to form new viral proteins.
 - (d) destroys the host cell's enzymes that govern transcription.

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 in this Question/Answer booklet. Wherever possible, confine your answers to the line spaces provided. Use a blue or black pen for this section. Only graphs and diagrams may be drawn in pencil.

Additional working space pages at the end of this Question/Answer booklet are for planning or continuing an answer. If you use these pages, indicate at the original answer, the page number it is planned/continued on and write the question number being planned/continued on the additional working space page.

Suggested working time: 90 minutes.

Question 31

(20 marks)

Cholera is a communicable disease that was first noticed amongst Portuguese sailors in the 16th century. The first major pandemic was recorded in 1871. The last pandemic began in 1961 and lasted 14 years. Despite modern medical treatment, Cholera still presents a significant problem in many third world countries today. Currently there is a major outbreak in the Yemen.

Cholera is an acute intestinal infection that causes nausea, vomiting and copious, watery diarrhoea. These symptoms can lead to severe dehydration and, if left untreated, death. Most deaths result from shock, which is caused by a severely reduced blood volume. Cholera has a short incubation period of between 1 and 5 days. Fatalities may be as high as 50% in communities without access to appropriate treatment.

The pathogen that causes Cholera is found in aquatic environments and harbouring within humans themselves. However, Cholera is rarely transmitted through person-to-person contact.

- (a) Suggest the most likely modes of transmission for Cholera. (2 marks)

- (b) Suggest how environmental factors could influence an outbreak of Cholera. (2 marks)

- (c) State **three (3)** preventative measures that would be most effective against the spread of Cholera. (3 marks)

- (d) Define the term 'pandemic'. (2 marks)

- (e) Explain why is it still possible for a Cholera pandemic to occur in the future. (3 marks)

Antibiotics are often used as a form of treatment for Cholera infections. However, resistance to some types of antibiotics is increasing in many regions susceptible to outbreak.

- (f) State the type of pathogen that causes Cholera. Explain your choice. (3 marks)

- (g) Explain how pathogens like this can become resistant to antibiotic treatment. (3 marks)

Vaccines are available that provide short-term protection. These are mostly used for travellers visiting affected regions.

- (h) Describe why health authorities would **not** recommend the use of vaccines to prevent Cholera outbreaks. (2 marks)

Question 32

(20 marks)

The Pygmy Sloth (*Bradypus pygmaeus*) is one of four, three-toed sloth species from the genus *Bradypus*. It was first identified as a separate species in 2001. The Pygmy Sloth is endemic to the small island *Isla Escudo de Veraguas*, which is situated off the north coast of Panama in the archipelago of Bocas del Tora. The remaining species of *Bradypus* can be found on other islands within this archipelago and on the mainland.

The Pygmy Sloth has attracted much attention due to the rapid evolution of its small body size, which is significantly smaller than the other *Bradypus* species and 40% smaller than its other mainland relatives. The Pygmy Sloth has a total body length of approximately 53cm and weighs up to 3.5kg. Its diet is restricted to the leaves of the Red Mangrove, in which it lives. These trees grow around the perimeter of the island. Unlike other mammals, the sloth is **not strictly** homoeothermic and must therefore live in warm, tropical climates. The fur of the Pygmy Sloth is tinted green due to algal symbionts residing in each hair strand. According to the IUCN, the Pygmy Sloth is critically endangered due to habitat degradation and illegal hunting.

Research on the *Bradypus* genus has suggested that the rapid evolution of the small body size (dwarfism) can be attributed to the geology and geography of the islands within the archipelago; age of the islands (time of isolation from mainland), area of the islands and distance from the mainland.

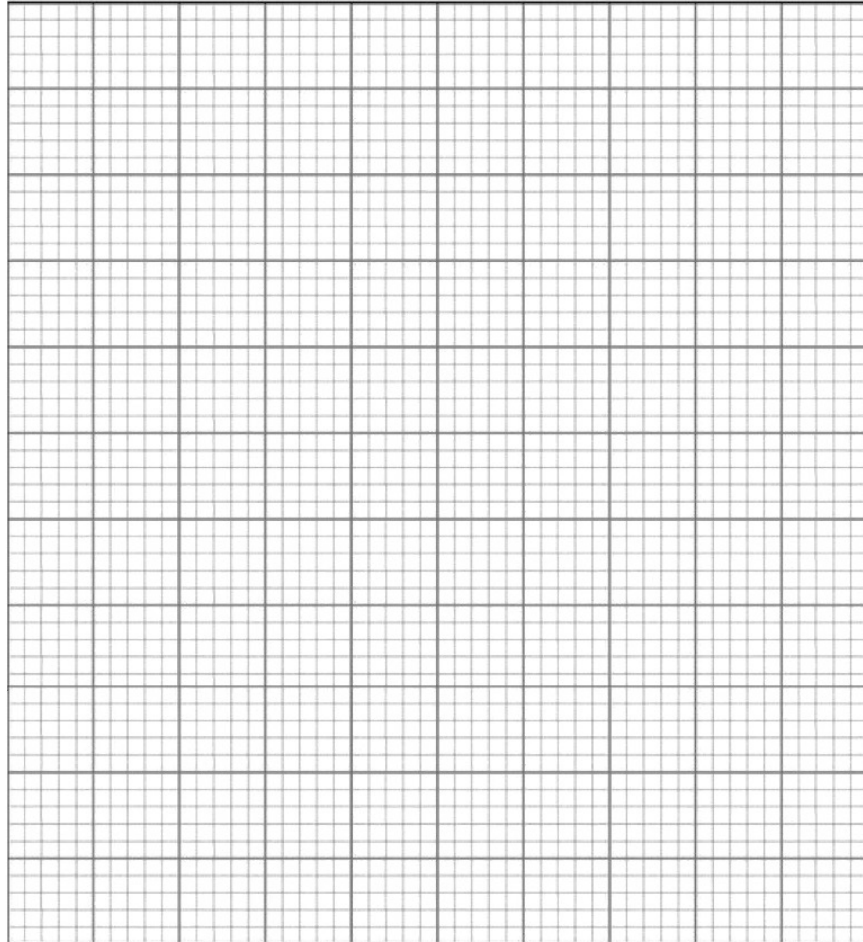
Consider the information provided in the table below regarding geological characteristics of the islands and the average skull size of their sloth inhabitants.

Table 1 – Average skull length (mm) of species from the *Bradypus* genus from islands of the Bocas del Tora archipelago, Panama.

Island Name	Time of isolation from mainland (years ago)	Distance from mainland (km)	Area of island (km ²)	Average skull length of sloth (mm)
Isla Escudo de Veraguas	8900	17.6	4.3	67
Isla Colon	5200	1.5	59.0	71
Isla Bastimentos	4700	6.3	51.5	73
Cayo Nancy	4700	9.5	6.8	76
Cayo Agua	3400	6.6	14.5	72
Isla Popa	1000	1.8	53.0	80
Isla Cristobal	1000	0.3	36.8	79

(Adapted from Anderson & Handley, 2002)

- (a) In the space provided below, construct an appropriate graph using the data regarding average skull length (mm) and time of isolation of islands from the mainland. (6 marks)
Spare graph paper is available in the additional working space section.



- (b) Describe the relationship between the variables shown in the graph. (2 marks)

- (c) Describe **two (2)** reasons why the other geographical factors **shown in the table** do not appear to have influenced the evolution of small size in the *Bradypus* sloths. (4 marks)

Island ecology is often of great interest to many scientists as many island ecosystems are characterised by species with interesting and exaggerated traits. Research has suggested that genetic drift and mutation can be ruled out as mechanisms for the rapid evolution of small body size in the Pygmy Sloth (*B. pygmaeus*).

- (d) Outline the mechanisms that have driven Pygmy Sloth evolution on Isla Escudo de Veraguas. (4 marks)

- (e) Describe **two (2)** ways in which the Pygmy Sloth's adaptations have assisted its survival despite negative human impact on its environment. (4 marks)

Question 33

(20 marks)

Gene cloning allows the replication of whole gene sequences and the subsequent production of its associated protein. Some species of bacteria have an important role to play in gene cloning as they can reproduce quickly and easily in the laboratory and contain plasmids.

- (a) Define the term 'bacterial plasmid'. (2 marks)

- (b) In the space below, construct a labelled diagram that shows the sequence of events for the technique that results in the formation of recombinant DNA in a bacterial cell. (6 marks)

The use of recombinant bacteria has been influential in the development of genetically modified crop species.

- (c) Outline **three (3)** major developments in agriculture as a result of recombinant DNA technology. (6 marks)

(i) _____

(ii) _____

(iii) _____

- (d) Describe **two (2)** possible negative effects on the environment as a result of the production of genetically modified crops. (4 marks)

- (f) Explain how biotechnology has helped improve the conservation of endangered species bred in captivity. (2 marks)

Question 34

(20 marks)

The chemical reactions of metabolic pathways produce wastes that must be excreted. These include carbon dioxide, nitrogenous wastes and water.

- (a) Explain why the removal of metabolic wastes from an organism is essential for continued metabolic activity. (3 marks)

The table below shows the nitrogenous wastes and excretory mechanisms of Australian animals.

Table 2 – Excretion of nitrogenous wastes in different Australian animal groups.

Animal	Type of nitrogenous waste	Concentration in urine	Organs of excretion
<i>Reptile</i>	Uric acid	High	Kidneys / Cloaca
<i>Bird</i>	Uric acid	High	Kidneys / Cloaca
<i>Freshwater fish</i>	Ammonia	Low	Kidneys / Gills
<i>Marsupial</i>	Urea	High	Kidneys / Bladder

- (b) Using the information in Table 2, explain the differences in nitrogenous waste production and excretion, in relation to the environment, for each animal group. (6 marks)

The structure and physiology of the kidney of mammals from arid environments is highly adapted to reduce water loss.

- (c) Describe the structure of the kidney from a desert marsupial and explain how this structure enables the marsupial to produce concentrated urine. (4 marks)

A group of biology students were asked to design an experiment regarding the effect of increased levels of ammonia in aquaculture hatcheries. Their aim was to:

'Find out the effect of increased ammonia concentration on the hatching success rate for a commercially produced aquaculture fish species.'

- (d) Propose a possible hypothesis for this investigation. (2 marks)

- (e) Identify the variables that should be considered to test this hypothesis.

- (i) Independent variable (1 mark)

- (ii) Dependent variable (1 mark)

Aquaculture is practiced worldwide. Collecting viable data from investigations such as this can be difficult due to large variations in water quality within and between aquaculture facilities.

- (f) Identify **three (3)** variables that must be controlled in this investigation to ensure viable data is collected. (3 marks)

Question 35

(20 marks)

- (a) Identify **three (3)** main reasons for constructing a phylogenetic tree in studies of evolutionary biology. (3 marks)

- (b) Describe the difference between distantly related and closely related organisms in terms of their:

- (i) DNA sequence. (3 marks)

- (ii) Position on a phylogenetic tree. (2 marks)

- (c) Describe **two (2)** other methods, using species' anatomy, that are used by evolutionary biologists to provide evidence for evolution. (4 marks)

Since the beginning of life on Earth, some 3.5 billion years ago, species evolution has coincided with environmental change. For organisms to survive significant changes in their environment, the process of sexual reproduction must provide for genetic variation.

- (d) Identify **two (2)** different ways that genetic variation can be increased as a result of sexual reproduction. (2 marks)

- (e) In the space below, draw a simple, labelled diagram to *explain* how genetic variation arises during **meiosis** through changes to chromosomes. (6 marks)

End of Section Two

See next page

Section Three: Extended Answer**(20%) 40 marks**

Section Three consists of **four (4)** questions.

Questions 36 and 37 are from Unit 3. Questions 38 and 39 are from Unit 4. Answer **one (1)** question from Unit 3 and **one (1)** question from Unit 4.

Use black or blue pen for this section. Only graphs and diagrams may be drawn in pencil. Responses can include: labelled diagrams with explanatory notes; lists of points with linking sentences; labelled tables and/or graphs; and/or annotated flow diagrams with introductory notes.

Additional working space pages at the end of this Question/Answer booklet are for planning or continuing an answer. If you use these pages, indicate at the original answer, the page number it is planned/continued on and write the question number being planned/continued on the additional working space page.

Suggested working time: 50 minutes

Unit 3

Choose **either** Question 36 **or** Question 37.

Indicate the question you will answer by ticking the box next to the question. Write your answer on pages 24 – 26. When you have answered your first question, turn to page 27 and indicate the second question you will answer on that page.

Question 36**(20 marks)**

DNA is the universal basis of life. It holds the 'blueprint' for how every living creature on Earth reproduces, grows and maintains metabolic processes.

- (a) Compare the processes of DNA replication and transcription in eukaryotic cells. (10 marks)

The process of DNA 'fingerprinting' allows scientists to visualise DNA for comparison and analysis. This technology can be applied to criminal investigations, paternity disputes, pharmaceutical productions and genetic disease identification.

- (b) Describe the technique used to visualise a nucleotide sequence from a molecule of DNA. Explain how this technique could enable a researcher to determine the relatedness between family members. (10 marks)

Question 37**(20 marks)**

Palaeontologists analyse fossils to obtain information regarding the history of life on Earth. Evolution sceptics believe that the fossil record does not provide comprehensive evidence for evolution because it is incomplete.

- (a) Describe the type of data that can be obtained directly from fossils. Explain how palaeontologists infer information from fossils to 'fill the gaps' in the fossil record to provide evidence of evolution. (10 marks)

Modern developments in biochemistry have enabled geneticists and evolutionary biologists to compare genetic information between organisms that are living or extinct.

- (b) Describe the comparative studies of DNA and mitochondrial DNA and explain how they can offer evidence for evolution. (10 marks)

Unit 4

Choose **either** Question 38 or Question 39.

Indicate the question you will answer by ticking the box next to the question. Write your answer on the pages provided.

 Question 38 **(20 marks)**

Australian arid ecosystems are characterised by organisms with specialised adaptations for thermoregulation. Floral and faunal species must cope with temperature extremes and long periods without access to fresh water.

- (a) Describe the behavioural adaptations of desert marsupials and explain how these adaptations support thermoregulation. Use examples to support your answer. (10 marks)
- (b) Identify and explain the adaptations of Australian xerophytes living in arid environments. (10 marks)

 Question 39 **(20 marks)**

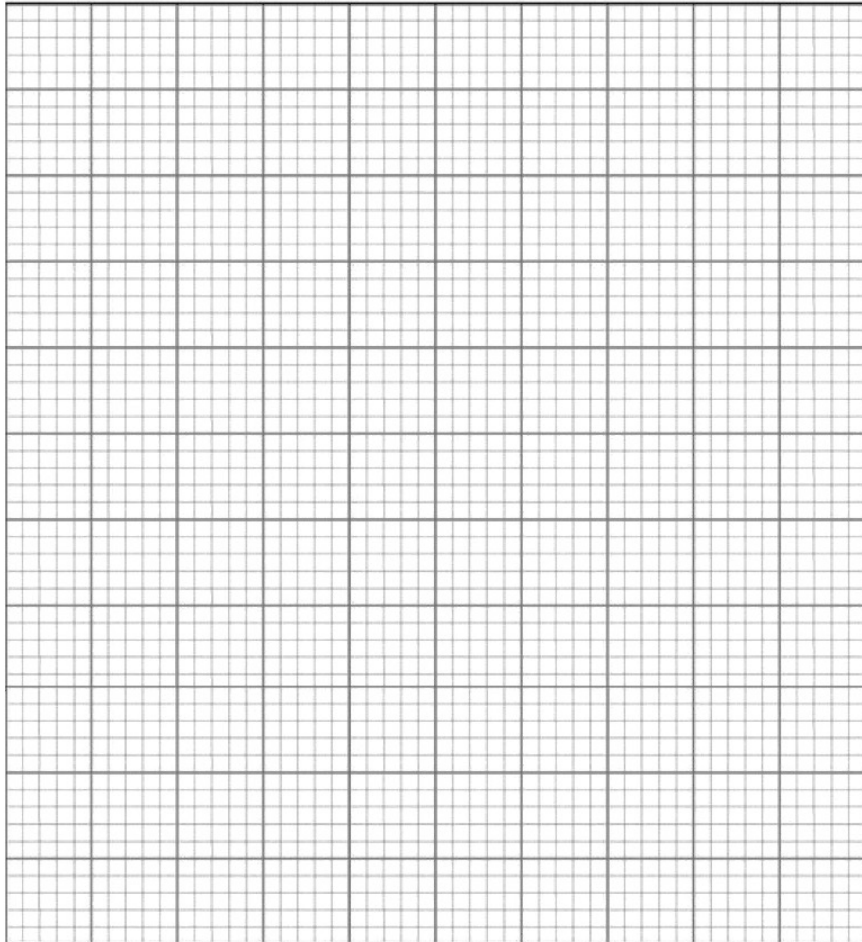
The transmission of infectious diseases is highly variable and the rate of transmission can change in response to external factors.

- (a) Describe the main factors that influence the transmission of disease-causing pathogens within and between populations. (10 marks)

Managing the spread of contagious disease involves the implementation of specific measures and effective communication between health authorities.

- (b) Using examples, describe the **three (3)** most common measures used to combat disease transmission in Australia. For each measure, identify a factor that may reduce its effectiveness. (10 marks)

Question 32 (a)



See next page

Acknowledgements

Question 32 Table data source: Anderson, R. P. & Handley, C. O., Jr. (2002, June). Dwarfism in insular sloths: biogeography, selection, and evolutionary rate. *Evolution* 56 (5), 1045 – 1058.