



ATAR course examination, 2019

Question/Answer booklet

BIOLOGY

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Place one of your candidate identification labels in this box.
Ensure the label is straight and within the lines of this box.
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WA student number: In figures

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In words

Time allowed for this paper

Reading time before commencing work: ten minutes
Working time: three hours

Number of additional
answer booklets used
(if applicable):

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, 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 examination
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 external examinations are detailed in the *Year 12 Information Handbook 2019*. Sitting this examination implies that you agree to abide by these rules.
- Write your answers in this Question/Answer booklet preferably using a blue/black pen. Do not use erasable or gel pens.
- 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. Do not use erasable or gel pens. 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 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. Write your answers in this Question/Answer booklet.

- You must be careful to confine your answers to the specific questions asked and to follow any instructions that are specific to a particular question.
- Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

See next page

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

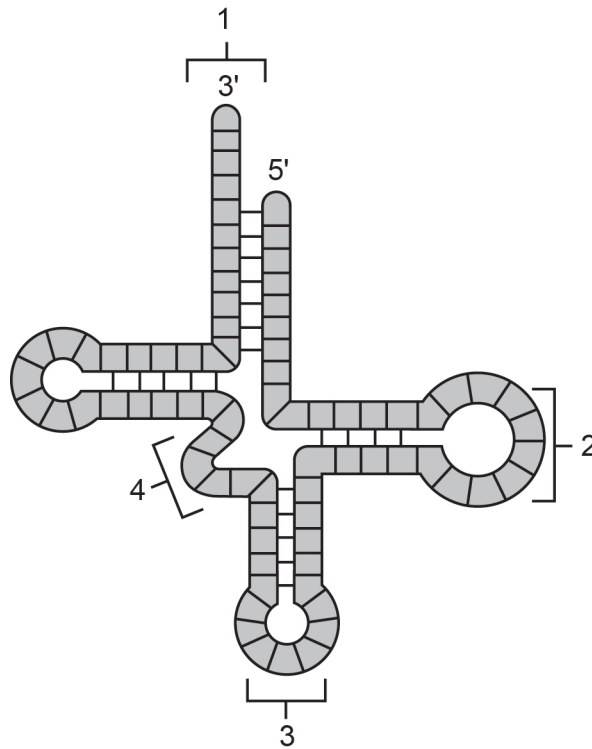
This section has **30** questions. Answer **all** questions on the separate Multiple-choice answer sheet provided. For each question shade the box to indicate your answer. Use only a blue or black pen to shade the boxes. Do not use erasable or gel pens. If you make a mistake, place a cross through that 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. A sudden increase in the number of people with an infectious disease in a location is called
- (a) an endemic.
 - (b) an epidemic.
 - (c) a pandemic.
 - (d) a peridemic.
2. A strand of DNA has the nucleotide sequence AGGTCT. The nucleotide sequence of the complementary strand of DNA is
- (a) AGGTCT.
 - (b) AGGUCU.
 - (c) TCCUGU.
 - (d) TCCAGA.
3. When the cells from a plant root are placed in a solution, they lose water to the solution. Relative to the cells, the solution is
- (a) hypertonic.
 - (b) hypotonic.
 - (c) isotonic.
 - (d) osmotic.
4. A virus
- (a) does not contain protein.
 - (b) does not contain nucleic acid.
 - (c) can synthesise both proteins and nucleic acids.
 - (d) cannot synthesise either proteins or nucleic acids.
5. Circular DNA that is **not** bound to proteins is typically found in
- (a) mitochondria.
 - (b) nuclei.
 - (c) ribosomes.
 - (d) vacuoles.

6. Select the correct statement.
- (a) Natural selection can result in the evolution of new species but artificial selection cannot.
 - (b) Artificial selection can result in the evolution of new species but natural selection cannot.
 - (c) Both natural and artificial selection can result in the evolution of new species.
 - (d) Neither natural nor artificial selection can result in the evolution of new species.
7. The **best** strategy for controlling the incidence of tetanus is the use of
- (a) antibiotics.
 - (b) antivirals.
 - (c) quarantine.
 - (d) immunisation.
8. Which of the following statements about the movement of DNA fragments through an agarose gel is correct?
- (a) Larger fragments move faster than smaller fragments because it is easier for them to move through the gel.
 - (b) Larger fragments move faster than smaller fragments because they have a higher negative charge.
 - (c) Smaller fragments move faster than larger fragments because it is easier for them to move through the gel.
 - (d) Smaller fragments move faster than larger fragments because they have a lower negative charge.
9. Select the correct statement.
- (a) All mammals excrete nitrogenous waste in the form of urine.
 - (b) All mammals excrete nitrogenous waste in the form of urea.
 - (c) Aquatic mammals excrete ammonia and land mammals excrete urine.
 - (d) Desert mammals excrete uric acid and other mammals excrete urea.
10. Like mammals, the fruit fly *Drosophila* has an XY system of sex determination. *Drosophila* usually have large, round eyes, but a dominant allele at the Bar gene on the X chromosome causes small, narrow eyes, called 'Bar eyes'. If a male with Bar eyes is crossed with a female with normal eyes, then
- (a) half of the female offspring will have Bar eyes but none of the males.
 - (b) half of the male offspring will have Bar eyes but none of the females.
 - (c) all of the male and female offspring will have Bar eyes.
 - (d) all of the female offspring will have Bar eyes but none of the males.

Questions 11 and 12 relate to the diagram of a RNA molecule below.



11. The structure at location 3 is
- a ribose sugar.
 - mRNA.
 - an anticodon.
 - a codon.
12. An amino acid will attach to this molecule at location
- 1.
 - 2.
 - 3.
 - 4.

13. Herd immunity
- (a) can be obtained through vaccination but not through natural infection.
 - (b) can be obtained through natural infection but not through vaccination.
 - (c) can be obtained through both vaccination and natural infection.
 - (d) cannot be obtained through either vaccination or natural infection.
14. Penguins have an inner layer of soft feathers that trap air close to the body. This reduces heat loss due to
- (a) conduction.
 - (b) convection.
 - (c) evaporation.
 - (d) radiation.
15. Penguins also have a thick layer of fat. This reduces heat loss due to
- (a) conduction.
 - (b) convection.
 - (c) evaporation.
 - (d) radiation.
16. Which of the following would lead to a significant decline in the incidence of malaria in an area?
- (a) People are exposed to the pathogen.
 - (b) People are treated with antibiotics.
 - (c) Stagnant water bodies are drained.
 - (d) Wild populations of bats are removed.
17. The early evolution and diversification of eukaryotes required increasing amounts of which of the following gases in the atmosphere?
- (a) oxygen
 - (b) carbon dioxide
 - (c) hydrogen
 - (d) nitrogen
18. A behavioural adaptation that some animals use to regulate their body temperature in a hot environment is
- (a) panting.
 - (b) burrowing.
 - (c) vasodilation.
 - (d) vasoconstriction.

Questions 19 and 20 relate to the information below.

Some businesses provide life insurance for pets. Data were obtained from one business on the cause of death of insured cats over the period 1999–2006. The data are shown in the table below.

Cause of death	Number of insured cats
kidney failure	907
traffic accidents	411
other accidents	153
skin cancers	165
blood cancers	235
other cancers	128
viral infections	407
bacterial infections	24
heart disease	421
hormonal disease	98

19. What proportion of cats in the data above died from cancers?
- (a) 0.04
 (b) 0.12
 (c) 0.14
 (d) 0.18
20. Which of the following is a valid conclusion from the data?
- (a) Few owners vaccinate their cats against viral infections.
 (b) Kidney failure is the most common cause of death in uninsured cats.
 (c) Infectious diseases killed more insured cats than heart disease.
 (d) Cat owners mainly insure their cats when the cats are ill.
21. Protists may have
- (a) mitochondria but not ribosomes or cell walls.
 (b) ribosomes but not mitochondria or cell walls.
 (c) ribosomes and cell walls but not mitochondria.
 (d) mitochondria, ribosomes and cell walls.
22. A mutation in a DNA sequence results in the substitution of one amino acid for another in a protein product. This mutation has produced a new
- (a) allele.
 (b) chromosome.
 (c) gene.
 (d) species.

See next page

23. Variation in the height of pea plants is discontinuous. Variation in the height of wheat plants is continuous. This suggests that height in pea plants is controlled by
- (a) a recessive allele, whereas height in wheat plants is controlled by a dominant allele.
 - (b) a dominant allele, whereas height in wheat plants is controlled by a recessive allele.
 - (c) multiple genes, whereas height in wheat plants is controlled by a single gene.
 - (d) a single gene, whereas height in wheat plants is controlled by multiple genes.
24. Which of the following is evidence for the process of evolution?
- (a) the fossil record has many gaps
 - (b) the Earth is about 4.5 billion years old
 - (c) all species share a genetic code
 - (d) interspecific hybrids are usually sterile
25. Freshwater bony fish mainly
- (a) gain salts by active transport through the skin.
 - (b) gain salts by active transport through the gills.
 - (c) lose salts by osmosis through the skin.
 - (d) lose salts by osmosis through the gills.
26. Genetic differences between populations are reduced by
- (a) gene flow.
 - (b) mutation.
 - (c) sexual selection.
 - (d) genetic drift.
27. Which of the following hypotheses would be the **most** difficult to test with a scientific experiment?
- (a) radiation changes DNA structure
 - (b) longevity in elephants is a polygenic trait
 - (c) doses of vitamin C prevent viral infections
 - (d) aquatic dinosaurs were ectothermic
28. A population of humpback whales was hunted almost to extinction before hunting was stopped. Since then, the population has been increasing. The genetic diversity of the population will
- (a) not have been affected by the changes in population size.
 - (b) not recover as quickly as the population size.
 - (c) have returned to pre-hunting levels as soon as the hunting stopped.
 - (d) be decreasing as the population size increases.

Questions 29 and 30 relate to the information below. The diagram shows the results of a laboratory experiment that measured sodium concentration in the blood plasma of Australian green tree frogs.

The frogs were either infected with a pathogen and showed symptoms of a disease (diseased), infected with the same pathogen but did not show symptoms of the disease (aclinical) or not infected with the pathogen (control).

The measurements were taken before any frogs were exposed to the pathogen (before infection) and 20 days (early infection) and 60 days (late infection) after the non-control frogs were exposed to the pathogen.

For copyright reasons this graph cannot be reproduced in the online version of this document.

29. The concentration of sodium in the blood plasma was
- (a) highest in the control frogs at all stages of infection.
 - (b) highest in all types of frog at the early infection stage.
 - (c) lower in the diseased frogs than in other frogs at the late infection stage.
 - (d) lower in the aclinical frogs than in other frogs before the infection.
30. Which of the following conclusions do the results support?
- (a) The disease symptoms are linked to a disruption of thermoregulation.
 - (b) The disease symptoms are linked to a disruption of osmoregulation.
 - (c) The pathogen causes disease symptoms within the first 20 days of infection.
 - (d) The pathogen always causes disease symptoms when present in these frogs.

End of Section One

See next page

Section Two: Short answer

50% (100 Marks)

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

Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

Suggested working time: 90 minutes.

Question 31

(19 marks)

Dung beetles are a type of insect and feed on animal faeces. A recent survey identified over 500 species of dung beetle that are native to Australia.

- (a) Define a species. (2 marks)

- (b) Explain how new species of dung beetle could evolve by allopatric speciation. (5 marks)

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Most dung beetle populations are small and experience genetic drift.

- (c) Describe how genetic drift affects the genetic composition of populations. (3 marks)

One species of dung beetle has males with larger horns than the females. The larger horns make movement and eating more difficult.

- (d) Explain how the larger horns in the males of this species could have evolved. (5 marks)

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Question 31 (continued)

A biologist constructed a phylogenetic tree showing the evolutionary relationships among the Australian species of dung beetle.

- (e) Explain how a phylogenetic tree can represent the evolutionary relationships among different species. (4 marks)

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Question 32

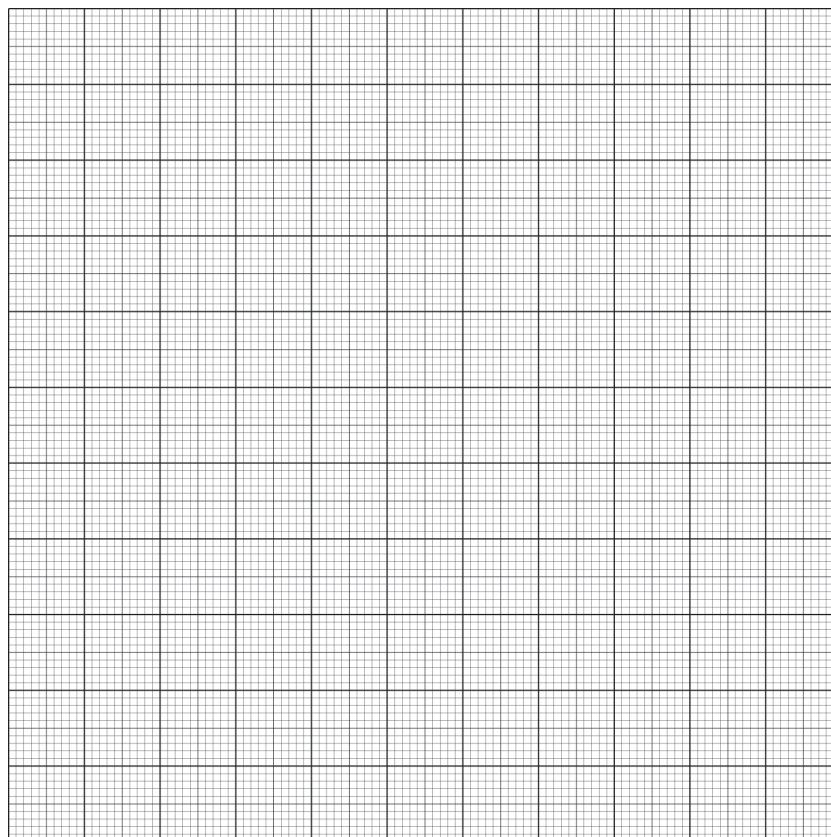
(21 marks)

The water flea, *Daphnia*, is a small crustacean that lives in freshwater. When *Daphnia* are examined under low magnification with a microscope, the heart is clearly visible and the beats can be counted. A biologist wanted to study the influence of temperature on the heart rate of *Daphnia*. He collected 50 *Daphnia*, randomly assigned 10 individuals to each of five temperatures and measured the heart rate of each individual after 15 minutes at the assigned temperature. The results are shown in the table below.

Temperature °C	Heart rate of 10 <i>Daphnia</i> (beats per 20 seconds)	
	Mean	Range
2	59	39–85
10	119	82–151
20	142	92–234
30	257	178–328
40	401	206–596

- (a) Graph the mean heart rate of the *Daphnia* against temperature.

(6 marks)



A spare grid is provided at the end of this Question/Answer booklet. If you need to use it, cross out this attempt and indicate clearly that you have redrawn it on the spare page.

See next page

Question 32 (continued)

(b) (i) Estimate the heart rate for *Daphnia* at 15 °C. (1 mark)

(ii) Estimate the heart rate for *Daphnia* at 45 °C. (1 mark)

(iii) In which estimate do you have the greater confidence? Give a reason for your answer. (2 marks)

(c) (i) What is the independent variable in this study? Give a reason for your answer. (2 marks)

(ii) State **one** way of improving the reliability of the study. (1 mark)

(iii) Propose an hypothesis for the study. (1 mark)

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- (d) Explain why the biologist waited for 15 minutes before measuring the heart rate of the *Daphnia* at the assigned temperature. (3 marks)

- (e) One of the *Daphnia* had a heart rate of 208 beats per 20 seconds. A biologist concluded that this *Daphnia* must have been assigned to a temperature of 30 °C. Evaluate this conclusion. (4 marks)

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Question 33

(20 marks)

(a) (i) Outline the role of the effector in homeostasis. (2 marks)

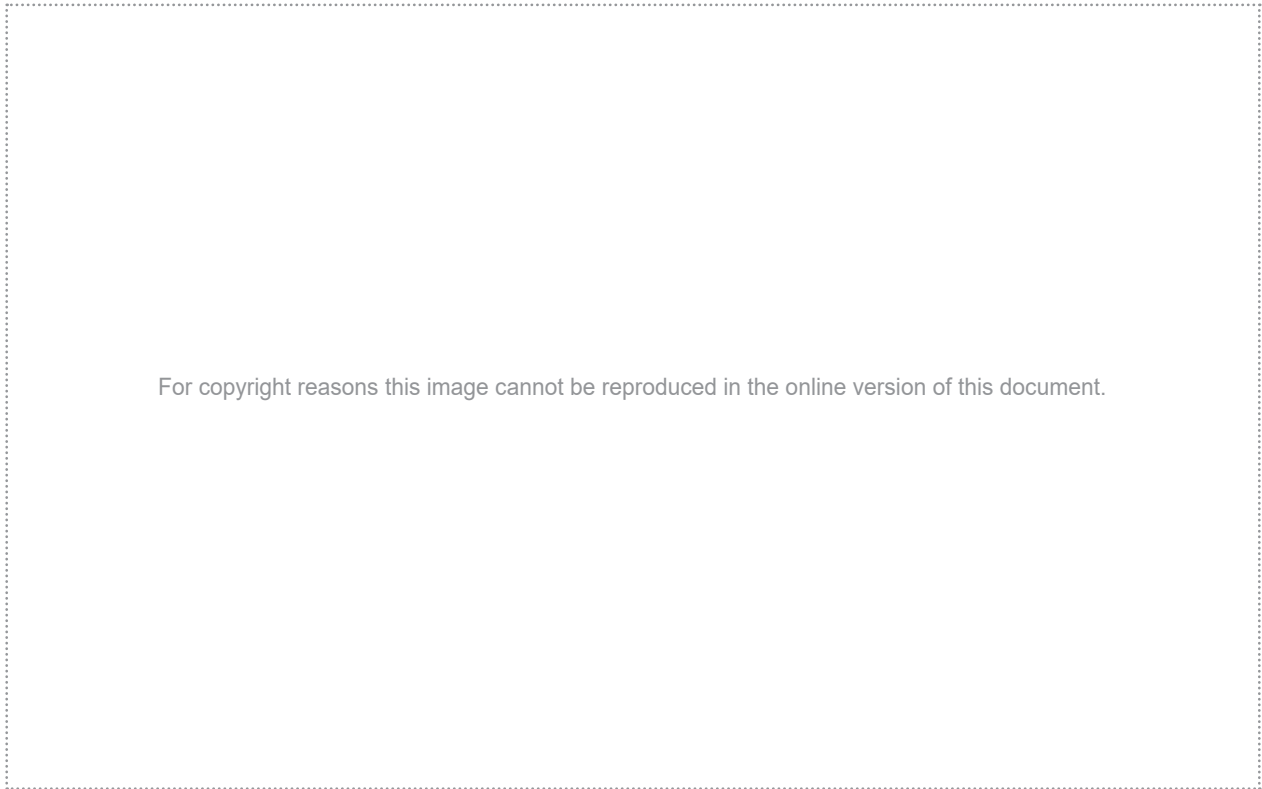
(ii) Outline the role of the receptor in homeostasis. (2 marks)

(iii) State the defining feature of a negative feedback loop. (1 mark)

(b) A marine fish regulates its water and salt balance. Is this an example of homeostasis? Give reasons for your answer. (3 marks)

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The diagram below shows a cross-section through a plant leaf.



- (c) List **four** features visible in the diagram above that would assist the plant to conserve water. (4 marks)

One: _____

Two: _____

Three: _____

Four: _____

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Question 33 (continued)

- (d) The root systems of xerophytes often include spreading roots just beneath the soil surface. Outline **two** advantages of these surface roots for xerophytes. (4 marks)

One: _____

Two: _____

- (e) Some xerophytes produce heat-shock proteins in response to heat stress. These proteins prevent the denaturation of other proteins. Explain how this could assist the survival of the xerophyte. (4 marks)

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Question 34

(20 marks)

(a) (i) Name a disease that is caused by a protist and can be spread by water. (1 mark)

(ii) Name a disease that is caused by a fungus and can be spread by water. (1 mark)

(iii) Name a human viral disease that is transmitted by an insect. (1 mark)

(iv) Name a human disease that is caused by a protist. (1 mark)

Crown gall is a disease of plants that is caused by some strains of *Agrobacterium* (sometimes called *Rhizobium*).

(b) Is crown gall an infectious disease? Give reasons for your answer. (3 marks)

(c) Describe the method used by *Agrobacterium* to invade the plant host. (4 marks)

See next page

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Question 34 (continued)

- (d) Describe the impact that *Agrobacterium* has on the plant host. (5 marks)

Agrobacterium is commonly used in the production of transgenic plants (its capacity to cause disease is deactivated first).

- (e) Outline the role that *Agrobacterium* plays in the production of transgenic plants and explain why it is well-suited to this role. (4 marks)

Question 35

(20 marks)

- (a) (i) State **two** similarities between binary fission and mitosis. (2 marks)

One: _____

Two: _____

- (ii) State **two** differences between binary fission and mitosis. (2 marks)

One: _____

Two: _____

- (b) Explain the role of fertilisation in sexual reproduction. (4 marks)

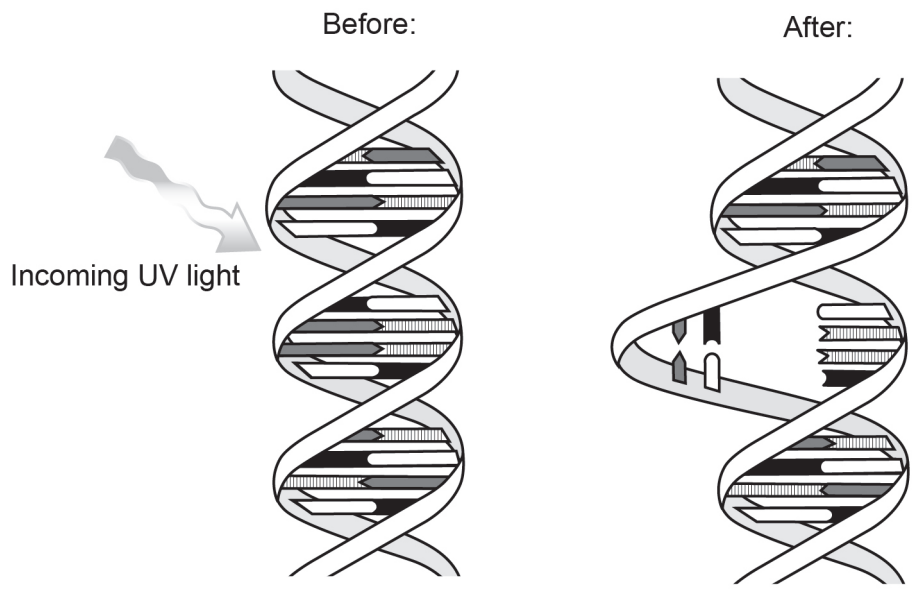
- (c) (i) Outline how crossing over creates genotypic variation. (2 marks)

- (ii) Outline how independent assortment creates genotypic variation. (2 marks)

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Question 35 (continued)

The following diagram shows the structure of a DNA molecule before and after exposure to ultraviolet (UV) light.



(d) Describe the effect that UV light has on DNA structure. (4 marks)

- (e) Explain why mutation is the ultimate source of genetic variation. (4 marks)

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End of Section Two

See next page

Section Three: Extended answer**20% (40 Marks)**

Section Three consists of **four** questions.

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

Use black or blue pen for this section. Do not use erasable or gel pens. 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.

Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

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 25–29. When you have answered your first question, turn to page 30 and indicate on that page the second question you will answer.

Question 36 **(20 marks)**

(a) Describe the functions of DNA and messenger RNA. (10 marks)

(b) Explain how speciation and macro-evolutionary changes result from an accumulation of micro-evolutionary changes over time. (10 marks)

Question 37 **(20 marks)**

(a) Describe how micro-evolution could result in salt tolerance in a species of plant. (10 marks)

(b) Explain how the use of transgenic crop plants may have adverse biological effects. (10 marks)

See next page

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)**

Most animals need to regulate their internal body temperature in order to survive and thrive. Endotherms and ectotherms use fundamentally different methods to achieve this. Each method is associated with particular costs and benefits to individuals.

- (a) Compare the methods that endotherms and ectotherms use to regulate their internal body temperature and discuss the costs and benefits of endothermy to individuals. (10 marks)

Humans regularly come into contact with a range of companion, livestock and wild vertebrates. These vertebrates can transmit diseases to humans. Diseases that are transmitted from non-human vertebrates to humans are called zoonoses.

- (b) Discuss the risk that zoonoses pose to human populations throughout the world. (10 marks)

Question 39 **(20 marks)**

In 1993 the World Health Organisation declared tuberculosis a 'global health emergency'. Since then considerable progress has been made in reducing the number of tuberculosis cases and deaths. It is, however, difficult to control the spread of this disease, which remains a serious threat to global health.

- (a) Explain why it is difficult to control the spread of tuberculosis. (10 marks)

Some mammals, such as the spinifex hopping mouse and greater bilby, live in the hot deserts of central Australia. These mammals have to survive in extreme heat with little water.

- (b) Explain the physiological challenges that a mammal faces in maintaining its internal environment within tolerance limits in hot deserts. (10 marks)

End of questions

Question number: _____

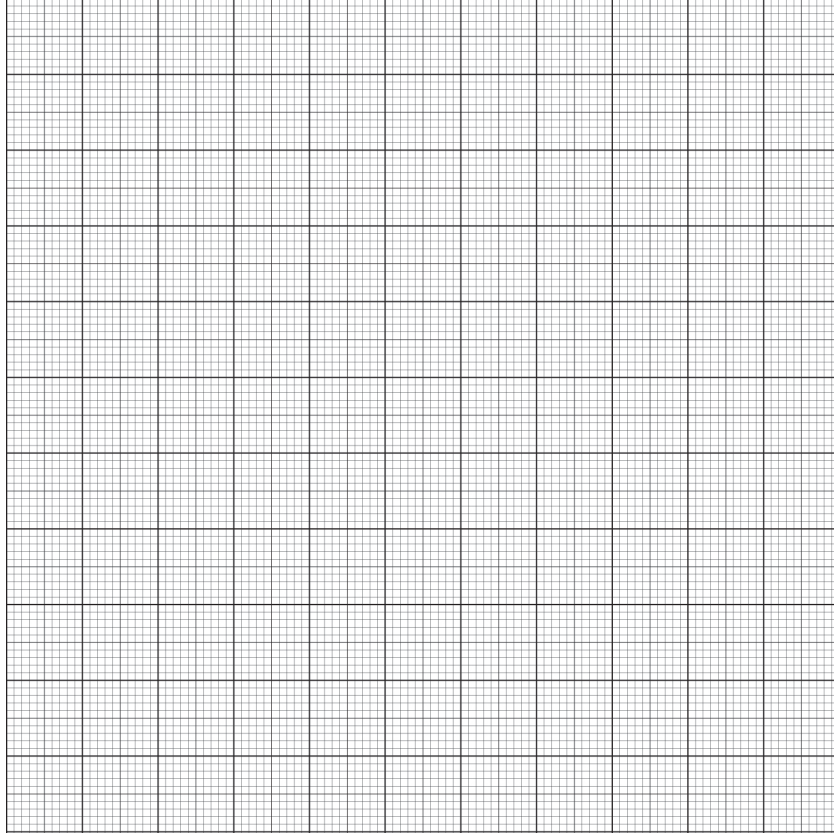
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Supplementary page

Question number: _____

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Spare grid



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ACKNOWLEDGEMENTS

- Questions 11–12** RNA molecule diagram adapted from: CNX OpenStax. (2016). OSC Microbio 11 04 tRNA.jpg. In *Wikipedia*. Retrieved February, 2019, from https://commons.wikimedia.org/wiki/File:OSC_Microbio_11_04_tRNA.jpg#file
Used under Creative Commons Attribution 4.0 International licence
- Questions 19–20** Data source: Egenvall, A., Nødtvedt, A., Hågström, J., et al. (2009). Mortality of life-insured Swedish cats during 1999-2006: age, breed, sex and diagnosis. *Journal of Veterinary Internal Medicine*, 23, pp. 1175–1183, Table 3.
- Questions 29–30** Figure adapted from: Voyles, J., Young, S., Berger, L., et al. (2009). Pathogenesis of [...], a cause of catastrophic amphibian declines. *Science*, 326(5952), pp. 582-585, Fig. 3.
- Question 32** Table adapted from: Nuffield Foundation & Society of Biology. (2018). *Investigating factors affecting the heart rate of daphnia*. Retrieved January, 2019, from <http://www.nuffieldfoundation.org/practical-biology/investigating-factors-affecting-heart-rate-daphnia>
- Question 33(c)** Diagram from: Raven, P. H., Evert, R. F. & Eichhorn S. E. (2005). *Biology of plants*. (7th ed.). W. H. Freeman and Company, p. 595, Fig. 25–22.
- Question 35(d)** Diagram from: NASA. (2014). *DNA UV mutation*. Retrieved March, 2019, from <https://en.wikipedia.org/wiki/Ultraviolet>

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