



## ATAR course examination, 2018

### Question/Answer booklet

# BIOLOGY

↑  
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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Student number: In figures

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In words

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### 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			
<b>Total</b>					100

## Instructions to candidates

- The rules for the conduct of the Western Australian external examinations are detailed in the *Year 12 Information Handbook 2018*. 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.

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1. In a DNA molecule, cytosine pairs with
- (a) adenine.
  - (b) guanine.
  - (c) thymine.
  - (d) uracil.
2. If 30% of the bases in a DNA molecule are adenine, what percentage will be guanine?
- (a) 20
  - (b) 30
  - (c) 60
  - (d) 70
3. Which of the following is an example of a scientific observation?
- (a) The cricket burrowed to avoid the heat of the day.
  - (b) Insects are going to dominate the earth.
  - (c) The elephant ate leaves from the acacia bush.
  - (d) Seabirds follow boats to obtain food from sailors.
4. The first organisms on Earth were
- (a) eukaryotic and aerobic.
  - (b) prokaryotic and aerobic.
  - (c) eukaryotic and anaerobic.
  - (d) prokaryotic and anaerobic.
5. Chytridiomycosis is a
- (a) fungal disease of plants.
  - (b) fungal disease of amphibians.
  - (c) bacterial disease of plants.
  - (d) bacterial disease of amphibians.

6. Which of the following statements about fungal and bacterial cells is **most** accurate?
- (a) Neither fungal cells nor bacterial cells have cell walls.
  - (b) Fungal cells have cell walls but bacterial cells do not.
  - (c) Fungal cells do not have cell walls but bacterial cells do.
  - (d) Both fungal and bacterial cells have cell walls.

Question 7 relates to the information below.

The following figure shows the total evaporative water loss (TEWL) as a function of body size in a range of desert and non-desert bird species.



7. The data in the figure suggest that
- (a) desert species lose more water than non-desert species.
  - (b) non-desert species lose more water than desert species.
  - (c) larger species lose more water than smaller species.
  - (d) smaller species lose more water than larger species.
8. A terrestrial bird will lose **most** water by
- (a) breathing.
  - (b) feeding.
  - (c) sweating.
  - (d) urinating.

9. Which of the following situations is **most** likely to lead to allopatric speciation?
- (a) Members of a fruit fly population breed on different species of trees.
  - (b) Members of a spider population are separated by a housing development.
  - (c) Members of a fish population migrate to an area to breed.
  - (d) Members of a plant population tolerate different quantities of heavy metals.
10. In protein synthesis, transcription is the process whereby
- (a) DNA is copied into messenger RNA.
  - (b) DNA is copied into transfer RNA.
  - (c) messenger RNA is copied into transfer RNA.
  - (d) transfer RNA is copied into messenger RNA.

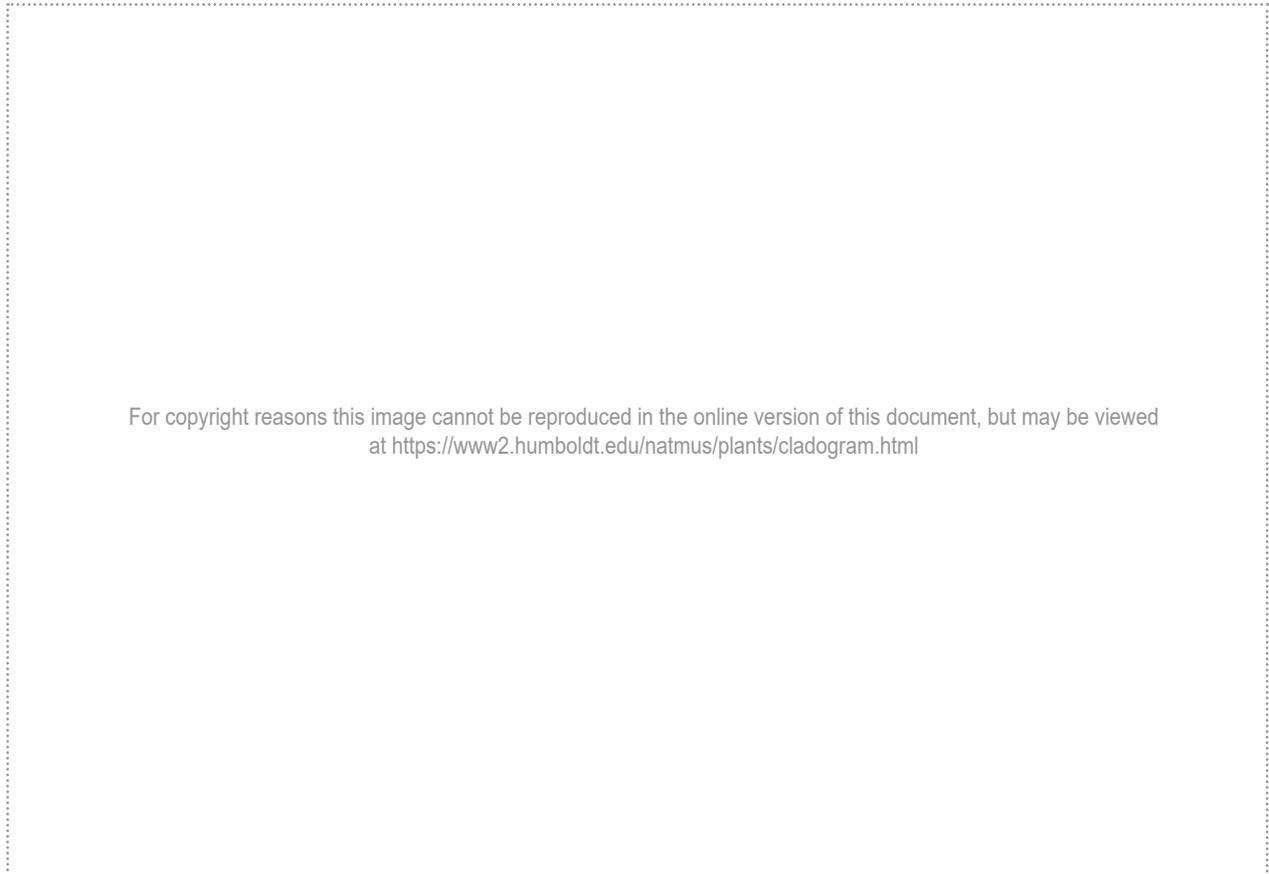
Questions 11 and 12 relate to the information below.

A biologist measured the internal temperatures of six healthy grasshoppers from the same species in their natural environment. The measurements were 32.8, 37.8, 35.0, 37.0, 33.0 and 36.7 °C. The environmental temperature at the time was 36 °C.

11. The median body temperature of the grasshoppers in °C was
- (a) 35.0.
  - (b) 35.4.
  - (c) 35.9.
  - (d) 36.0.
12. The mechanism for temperature regulation in these grasshoppers is
- (a) endothermy, because they maintain their body temperature above the environmental temperature.
  - (b) ectothermy, because they maintain their body temperature above the environmental temperature.
  - (c) endothermy, because they have body temperatures that are close to 37.0 °C.
  - (d) ectothermy, because they have different body temperatures at the same environmental temperature.
13. In order to be regarded as infectious, a disease must be
- (a) caused by a pathogen.
  - (b) caused by a mutation.
  - (c) able to infect humans.
  - (d) able to infect animals.

Questions 14 and 15 relate to the information below.

The following phylogenetic tree shows the relationships among the major groups of plants and the points in their evolution at which particular characteristics arose. The time frame is in millions of years ago (MYA).



14. The phylogenetic tree indicates that

- (a) seeds evolved after flowers.
- (b) woody tissue evolved after xylem and phloem.
- (c) cycads have woody tissue and flowers.
- (d) cuticle is present in ferns but not in mosses.

15. The phylogenetic tree also indicates that

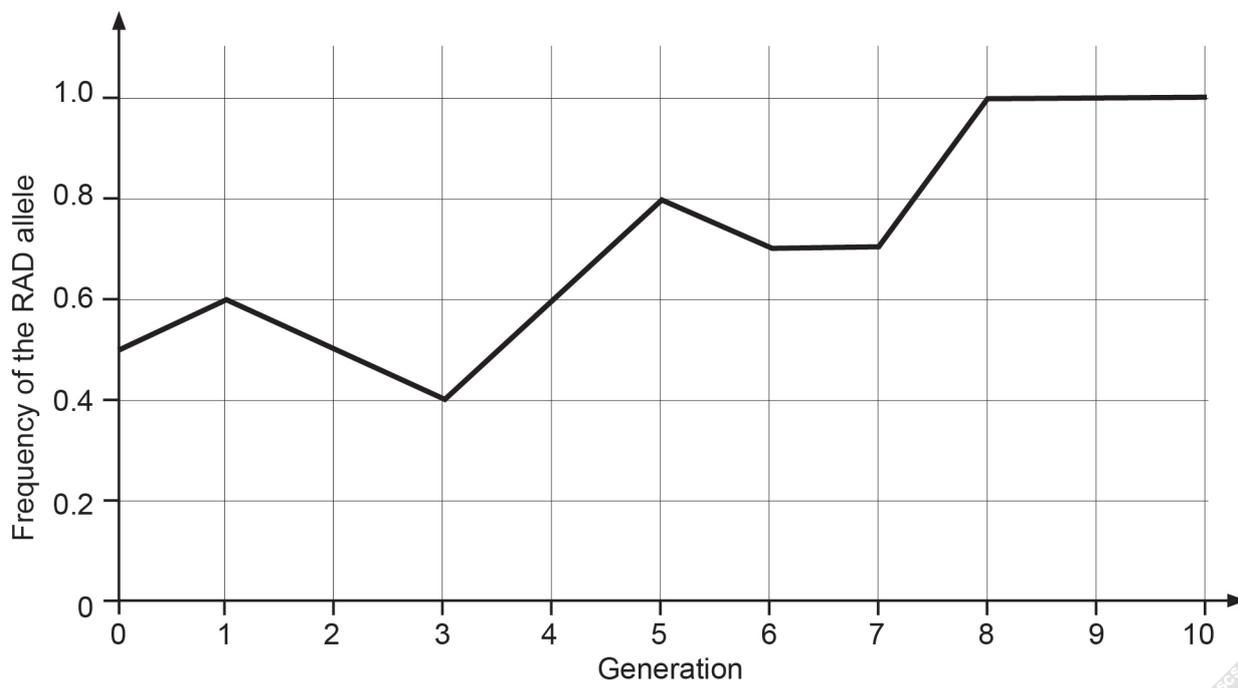
- (a) angiosperms evolved from mosses and ferns.
- (b) gymnosperms evolved from angiosperms.
- (c) liverworts, hornworts and mosses form a single related group of plants.
- (d) cycads, ginkgoes and conifers form a single related group of plants.

**See next page**

16. A pandemic is **most** likely to arise from a new influenza virus strain that
- (a) spreads easily among humans.
  - (b) causes a high mortality rate in humans.
  - (c) cannot replicate in humans.
  - (d) has the same protein coat as an existing strain.
17. Tail length in mice is a polygenic trait. This means that variation in tail length in a population of mice will be
- (a) discontinuously distributed and controlled by the alleles at multiple genes.
  - (b) discontinuously distributed and controlled by the alleles at a single gene.
  - (c) continuously distributed and controlled by the alleles at multiple genes.
  - (d) continuously distributed and controlled by the alleles at a single gene.
18. During DNA replication, the two new DNA strands are synthesised from the template strands at the same time. The two new strands are synthesised
- (a) in the same direction.
  - (b) in opposite directions.
  - (c) by RNA polymerase.
  - (d) by DNA helicase.
19. In animal cells, DNA occurs in the
- (a) nucleus and mitochondria.
  - (b) nucleus and ribosomes.
  - (c) ribosomes and mitochondria.
  - (d) mitochondria and chloroplasts.
20. A lizard lying on a rock that is warmer than the body of the lizard will
- (a) lose heat to the rock by convection.
  - (b) lose heat to the rock by conduction.
  - (c) gain heat from the rock by convection.
  - (d) gain heat from the rock by conduction.

Questions 21 and 22 relate to the information below.

The following figure shows the frequency of an allele (RAD) for a gene in a population for 11 generations.



21. The frequency of the RAD allele in the population in Generation 3 is approximately
- (a) 0.2.
  - (b) 0.4.
  - (c) 0.6.
  - (d) 0.8.
22. By Generation 8, the frequency of the RAD allele is 1.00, which means that it is now the only allele present for this gene in this population. Which of the following needs to occur before evolution can take place at this gene after Generation 8?
- (a) genetic drift
  - (b) meiosis
  - (c) mutation
  - (d) natural selection
23. Biogeography is the study of
- (a) population dynamics.
  - (b) reproductive behaviour.
  - (c) infectious diseases.
  - (d) species' distributions.

24. Crown gall disease in plants is caused by a
- (a) bacterium that enters the plant through stomata in the leaves.
  - (b) bacterium that enters the plant through wounds in the roots or stem.
  - (c) virus that enters the plant through stomata in the leaves.
  - (d) virus that enters the plant through wounds in the roots or stem.

Question 25 refers to the information below.

The following lists the main steps in a genetic engineering experiment in no particular order.

- Step A. Enzyme cuts source DNA at specific sites.
  - Step B. Bacterial cells with recombinant plasmid reproduce.
  - Step C. Source DNA is combined with a plasmid.
  - Step D. Bacterial cells with recombinant plasmid are selected.
25. Which of the following lists these steps in the order in which they occur in the experiment?
- (a) A – C – D – B
  - (b) B – D – A – C
  - (c) C – B – A – D
  - (d) D – C – B – A
26. In genetic engineering, plant viruses are sometimes used to introduce a foreign gene into a plant cell. This is because viruses are
- (a) non-living and therefore easy to store in the laboratory.
  - (b) non-living and therefore there are no ethical issues with using them in this way.
  - (c) able to invade the cell and produce a large number of viral particles very quickly.
  - (d) able to invade the cell and merge their genetic material with that of the cell.
27. The males of some species of beetle have much larger horns than the females. These horns decrease the chances of the males surviving but increase their chances of finding mates. The large horns of the male beetles have likely to have evolved via
- (a) natural selection, where the males compete with each other for mates.
  - (b) natural selection, where the females compete with each other for mates.
  - (c) sexual selection, where the males compete with each other for mates.
  - (d) sexual selection, where the females compete with each other for mates.

Questions 28 to 30 refer to the information below.

A biologist conducted an experiment to test the ability of four species of small mammal to produce concentrated urine during periods of water shortage. The biologist measured the concentration of salt in the urine and blood in dehydrated individuals of each species. The results were expressed as the ratio of the concentration of salt in the urine to the concentration of salt in the blood (U:B ratio) and are given in the table below.

Species	U:B ratio
A	8:1
B	9.5:1
C	10:1
D	16:1

28. The results show that the concentration of salt in the urine was
- (a) lower than that in the blood in species A.
  - (b) higher than that in the blood in species B.
  - (c) lower in species D than in species C.
  - (d) higher in species A than in species B.
29. From the results, the species **most** likely to inhabit a dry environment is
- (a) A.
  - (b) B.
  - (c) C.
  - (d) D.
30. The concentration of salt in the urine and blood was measured using dehydrated individuals to
- (a) include a dependent variable in the experiment.
  - (b) include an independent variable in the experiment.
  - (c) improve the validity of the experiment.
  - (d) improve the reliability of the experiment.

**End of Section One**

**See next page**

**Section Two: Short answer****50% (100 Marks)**

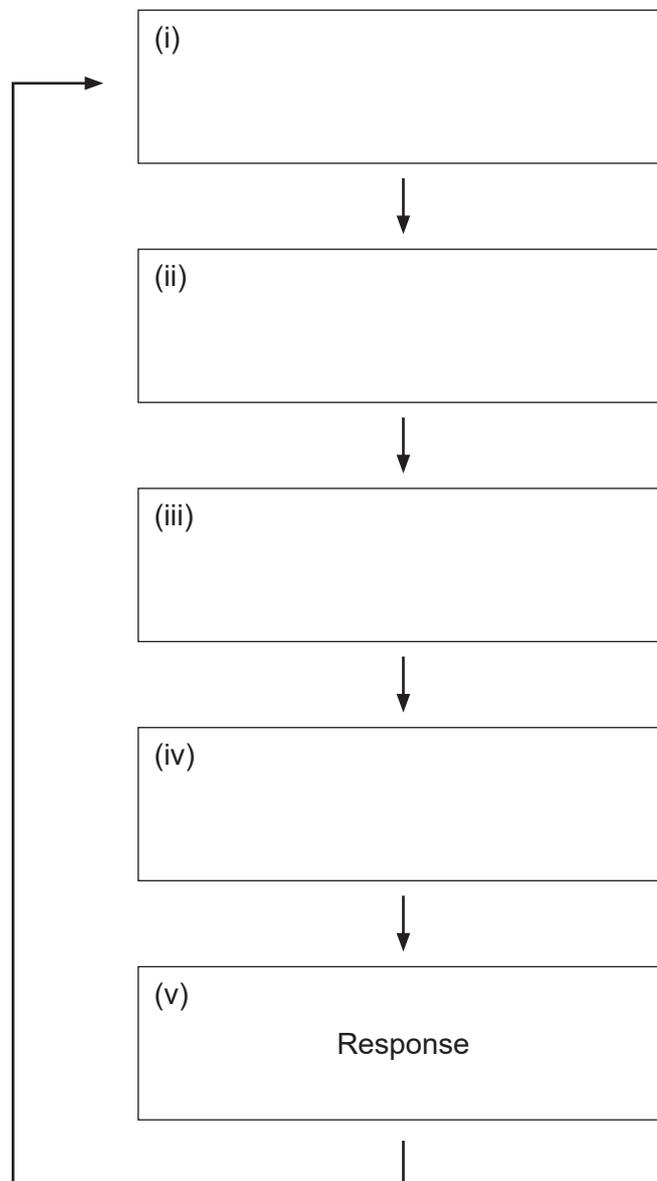
This section has **five** questions. Answer **all** questions. Write your answers in the spaces provided.

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****(20 marks)**

- (a) A stimulus-response model consists of several parts, which are represented by the boxes in the diagram below. The part represented by box (v) has been labelled. Complete the diagram by placing the correct labels for the different parts of the model in boxes (i) to (iv). (4 marks)



See next page

**Question 31** (continued)

Vertebrates produce three main types of nitrogenous waste.

- (b) Complete the table below to indicate the type of nitrogenous waste excreted by each animal. (4 marks)

Animal	Type of nitrogenous waste excreted
Desert rat	
Bony fish	
Insect-eating bird	
River dolphin	

- (c) (i) Which type of nitrogenous waste is the most toxic? (1 mark)

\_\_\_\_\_

- (ii) List the main types of nitrogenous waste in order from the one that takes the least amount of energy to produce to the one that takes the most energy. (3 marks)

One (least amount of energy): \_\_\_\_\_

Two: \_\_\_\_\_

Three: \_\_\_\_\_

- (d) Explain the circumstances in which it is an advantage to an animal to excrete uric acid. (4 marks)

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(e) Marine bony fish excrete only a small volume of urine. Explain why.

(4 marks)

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Question 32

(20 marks)

The diploid numbers of chromosomes in the horse and donkey are 64 and 62 respectively. A mule is the offspring of a cross between a horse and a donkey. Mules survive but are sterile because they cannot produce functional gametes.

- (a) On the basis of the above information, how many chromosomes would be present in a diploid cell of a mule? Explain your answer. (4 marks)

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- (b) Explain why mules cannot produce functional gametes. (4 marks)

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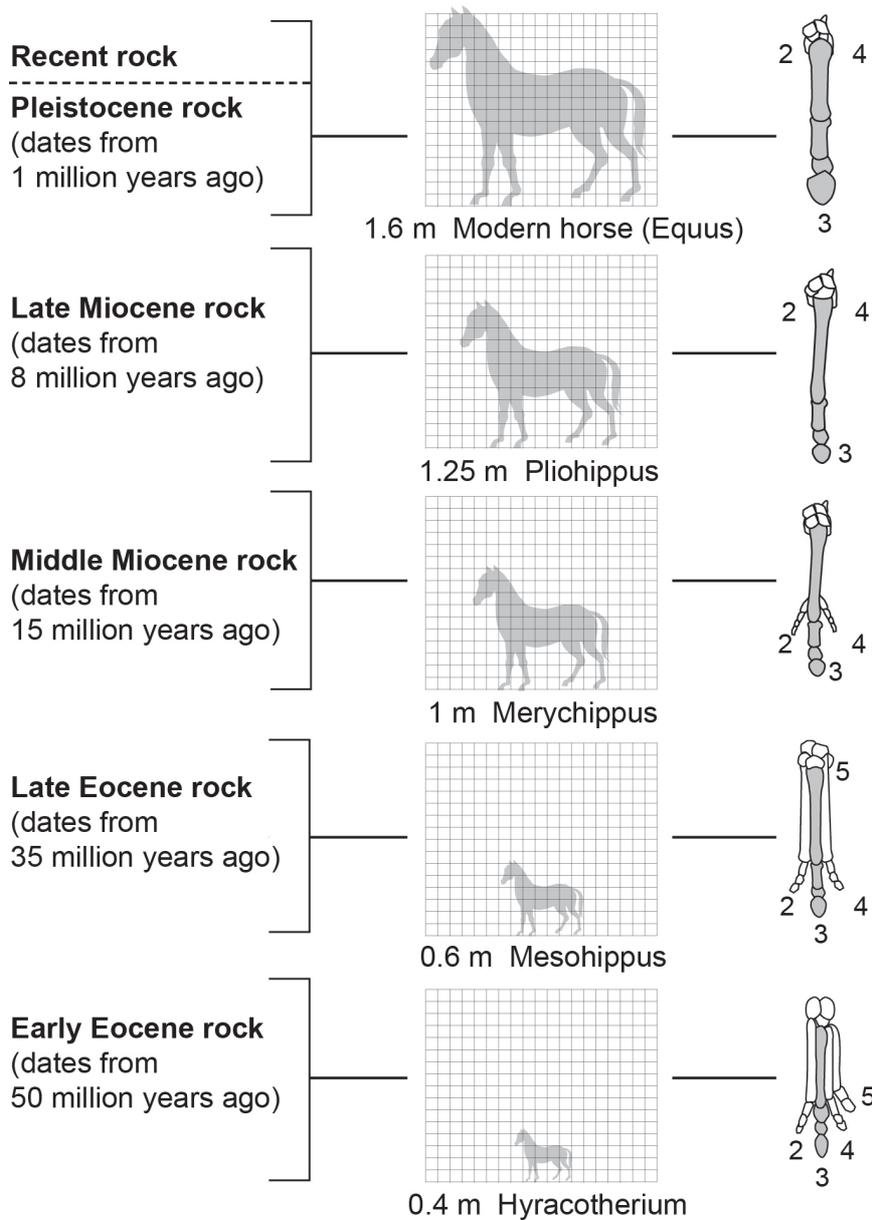
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The following diagram shows the evolution of height and forefeet in modern horses and their extinct ancestors over the past 50 million years. The different digits ('fingers') of the forefeet are labelled 2 to 5.



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(c) Describe the main features of the evolution of the forefeet in horses over the past 50 million years. (4 marks)

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See next page

**Question 32** (continued)

- (d) Explain how biologists know about the evolution of the forefeet in horses over the past 50 million years. (4 marks)

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- (e) Is the evolution of horse forefeet an example of microevolution or macroevolution? Explain your answer. (4 marks)

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**Question 33**

**(20 marks)**

Albinism is an inherited trait that results in a lack of colour in the eyes and fur of mammals, including guinea pigs. Non-albino guinea pigs have coloured fur.

- (a) A non-albino male and a non-albino female guinea pig were crossed and produced a litter containing some albino and some non-albino offspring. Explain in words how non-albino guinea pigs can produce albino offspring. (3 marks)

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- (b) Both male and female albino offspring were produced in the cross described in part (a). On this basis, explain in words why albinism cannot be a sex-linked trait in guinea pigs. (4 marks)

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**Question 33** (continued)

- (c) (i) What is the probability of obtaining an albino offspring from the cross described in part (a)? (1 mark)

Answer: \_\_\_\_\_

- (ii) In the space below draw a punnett square to show how you obtained your answer in part (c)(i). Indicate clearly the genotypes and phenotypes of the offspring. (4 marks)

- (d) Albino guinea pigs are common in captive populations but rare in wild populations. Explain this difference. (4 marks)

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A breeder kept only albino guinea pigs. The breeder put one female and two male guinea pigs in the same enclosure. The female had a litter of offspring. The breeder wanted to know which of the male guinea pigs was the father of the litter.

- (e) Explain how biotechnology can be used to determine the father of the litter. (4 marks)

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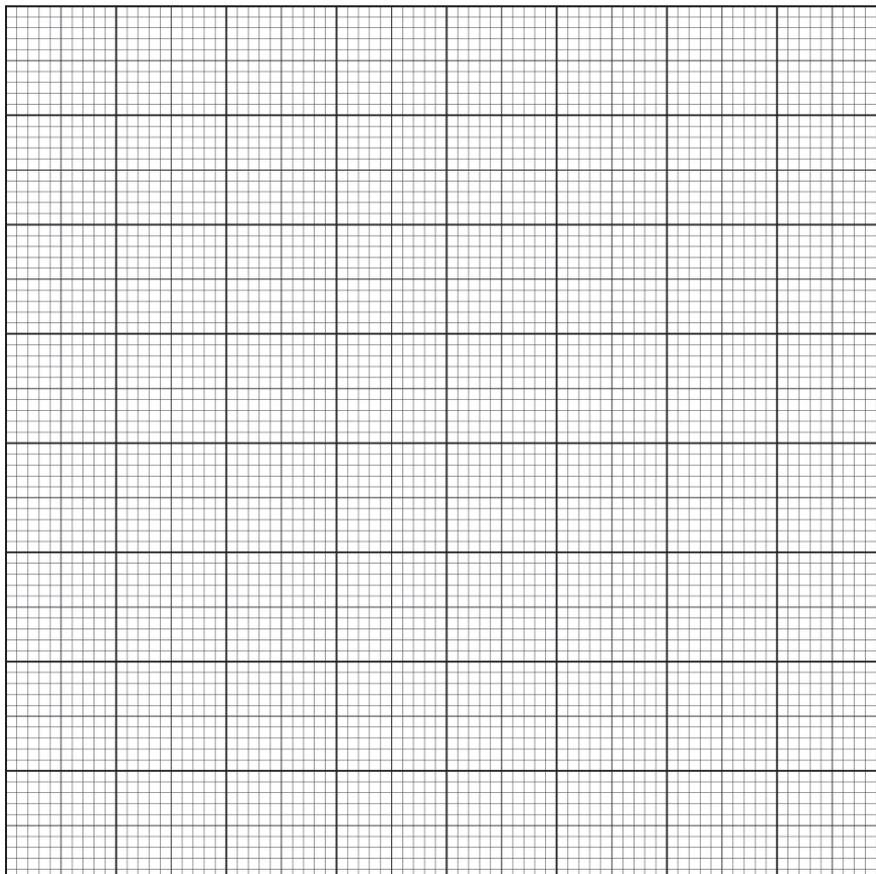
Question 34

(20 marks)

Soil salinity is a problem in agricultural areas because many crop species cannot tolerate high concentrations of salt. Biologists conducted an experiment to investigate why barley is more tolerant of soil salt than lupins. They germinated 90 barley plants and 90 lupin plants and grew the plants in identical conditions except for the variation in the concentration of salt in the soil. After six weeks, the biologists measured the concentration of salt in the xylem tissue of the plants. The results are shown in the table below.

Salt concentration in soil (mM)	Mean salt concentration in the xylem (mM)	
	Barley	Lupins
0	0	0
25	2	No data
50	2	3
75	No data	7
100	5	6
125	No data	6
150	4	No data
175	No data	59
200	7	No data

- (a) Graph the mean salt concentration found in the xylem for both barley and lupins against the salt concentration in the soil. (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 clearly indicate that you have redrawn it on the spare page.

See next page

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- (b) (i) Estimate the mean xylem salt concentration for barley for a soil salinity of 175 mM. (1 mark)

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- (ii) Estimate the mean xylem salt concentration for lupins for a soil salinity of 150 mM. (1 mark)

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- (iii) In which of the above estimates do you have more confidence? Give a reason for your answer. (2 marks)

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- (c) Explain why the biologists grew the plants under identical conditions except for the variation in soil salinity. (3 marks)

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- (d) Explain why the biologists used 90 plants of each species rather than 18. (3 marks)

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**Question 34** (continued)

- (e) Barley plants are more tolerant of soil salt than lupins. Use the results of the experiment to deduce why barley plants are more tolerant of soil salt than lupins. (4 marks)

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**Question 35**

**(20 marks)**

Malaria and tuberculosis are infectious diseases of humans.

- (a) Malaria is caused by a protist. Describe the main structural features of protists. (4 marks)

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- (b) Describe how malaria is transmitted from an infected person to an uninfected person. (4 marks)

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Question 35 (continued)

(c) Outline **two** distinctly different methods of controlling the spread of malaria. (4 marks)

One: \_\_\_\_\_

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\_\_\_\_\_

\_\_\_\_\_

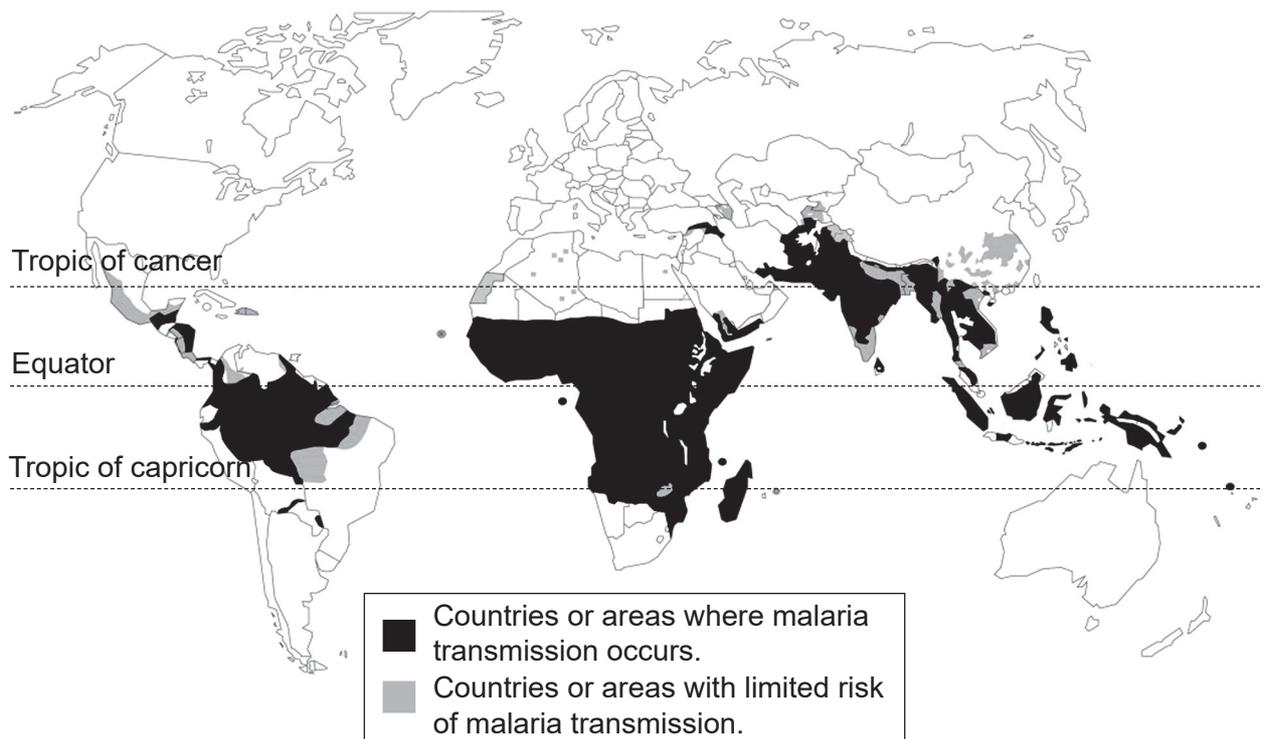
Two: \_\_\_\_\_

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\_\_\_\_\_

\_\_\_\_\_

The map below shows the worldwide distribution of malaria. Malaria is present in those areas that are shaded.



See next page

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(d) Describe the distribution of malaria. (3 marks)

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(e) Unlike malaria, tuberculosis occurs throughout the world. Explain why tuberculosis is much more widely distributed than malaria. (5 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. 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.

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**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 27–31. When you have answered your first question, turn to page 32 and indicate on that page the second question you will answer.

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**Question 36** **(20 marks)**

- (a) A mutation causes the deletion of one nucleotide from the DNA in a cell. Discuss the likely consequences of this mutation on protein production and on the structure and function of the cell. (10 marks)
- (b) Discuss how 'genetic drift' and 'gene flow' change allele frequencies in the gene pool of a population. (10 marks)

**Question 37** **(20 marks)**

- (a) Discuss how environmental factors can cause mutations in genes and how errors in meiosis can cause mutations in chromosome numbers. (10 marks)
- (b) Discuss why populations with reduced genetic diversity face an increased risk of extinction and how biotechnology can be used to reduce this risk. (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)**

- (a) The Arctic fox (shown in the photograph below) lives in the Arctic tundra, which is one of the coldest environments on Earth.



Discuss **one** structural feature and **one** physiological process that enables mammals living in cold environments to maintain a constant core body temperature. Identify clearly in your answer which is the structural feature and which is the physiological process.

**(10 marks)**

- (b) Discuss how population density and the provision of healthcare can influence the susceptibility of an urban area to an influenza epidemic. **(10 marks)**

**Question 39****(20 marks)**

- (a) Discuss how phytophthora dieback disease spreads and the management strategies that can be used to control the spread of this disease. **(10 marks)**

- (b) Discuss how a xerophyte minimises water loss while still allowing for gas exchange. **(10 marks)**

**End of questions**





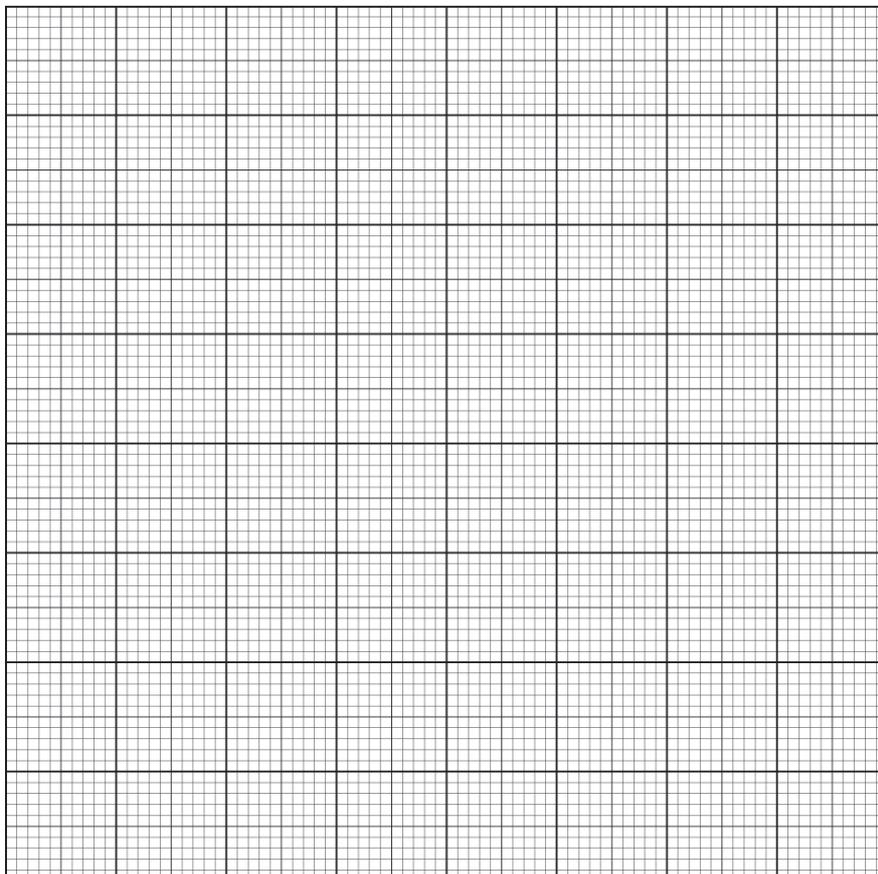








Spare grid



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## ACKNOWLEDGEMENTS

- Question 7** Figure from: Williams, J. B., & Tieleman, B. I. (2005, May). Physiological adaptation in desert birds. *BioScience*, 55(5), p. 419, fig. 3a. Retrieved March, 2018, from [https://doi.org/10.1641/0006-3568\(2005\)055\[0416:PAIDB\]2.0.CO;2](https://doi.org/10.1641/0006-3568(2005)055[0416:PAIDB]2.0.CO;2)
- Questions 14 & 15** Phylogenetic tree diagram from: [Plants] (Cladogram of plant evolution). (n.d.). Retrieved March, 2018, from <https://www2.humboldt.edu/natmus/plants/index.html>
- Question 32(c–e)** Diagram adapted from: Mcy jerry. (2005). File:Horseevolution.png. In *Wikipedia*. Retrieved March, 2018, from <https://commons.wikimedia.org/wiki/File:Horseevolution.png>  
Used under Creative Commons Attribution-Share Alike 3.0 Unported licence.
- Question 34** Table data source: Atwell, B. J., Kriedemann, P. E., & Turnbull, C. G. N. (Eds). (1999). *Plants in action: Adaptation in nature, performance in cultivation* (Ch. 17.2.1: Annual plants, fig. 17.6). Retrieved March, 2018, from <http://plantsinaction.science.uq.edu.au/edition1/?q=content/17-2-1-annual-plants>
- Question 35(d–e)** Figure adapted from: World Health Organization. (2011). *Malaria, countries or areas at risk of transmission, 2010*. Retrieved May, 2018, from [http://gamapserv.who.int/mapLibrary/Files/Maps/Global\\_Malaria\\_ITHRiskMap.JPG?ua=1](http://gamapserv.who.int/mapLibrary/Files/Maps/Global_Malaria_ITHRiskMap.JPG?ua=1)
- Question 38(a)** Photograph from: Emma. (2011). [Arctic fox]. Retrieved March, 2018, from <https://www.flickr.com/photos/emmabishop/6375703941/>  
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