



Western Australian Certificate of Education Sample Examination, 2016

Question/Answer Booklet

BIOLOGY

Please place your student identification label in this box

Student Number: In figures

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In words

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

Number of additional
answer booklets used
(if applicable):

To be provided by the candidate

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

Special items: up to three 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 any unauthorised notes or other items of a non-personal nature in the examination room. 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
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 Western Australian external examinations are detailed in the *Year 12 Information Handbook 2016*. 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 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.

Sections Two and Three: Write your answers in the spaces provided in this Question/Answer Booklet. Wherever possible, confine your answers to the line spaces provided. Use a black or blue pen (not pencil) for this section. Only the graph may be drawn in pencil.

Section Three consists of **four** questions. You must answer **two** questions, one from Unit 3 and one from Unit 4. Tick the box next to the question you are answering. Do **not** copy the questions when answering. Answers can be presented in a variety of ways: using clearly-labelled tables and graphs or diagrams with explanatory notes, writing lists of points with linking sentences or drawing annotated flow diagrams with introductory notes.

- 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.
- 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 that you are continuing to answer at the top of the page.

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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. If 20% of the nucleotides in a DNA fragment contain cytosine, what percentage will be thymine?
 - (a) 20
 - (b) 30
 - (c) 40
 - (d) 50

2. Which of the following statements best describes a difference between the terms 'hypothesis' and 'theory'?
 - (a) Theories are proven hypotheses.
 - (b) Theories are supported by more evidence than are hypotheses.
 - (c) Hypotheses and theories are different names for the same concept.
 - (d) Theories can be tested experimentally, whereas hypotheses cannot.

3. Which one of the following statements about the gene pool is most accurate?
 - (a) The gene pool contributes to biodiversity.
 - (b) Mutation decreases the size of the gene pool.
 - (c) Genetic drift increases the size of the gene pool.
 - (d) Natural selection causes random changes in the gene pool.

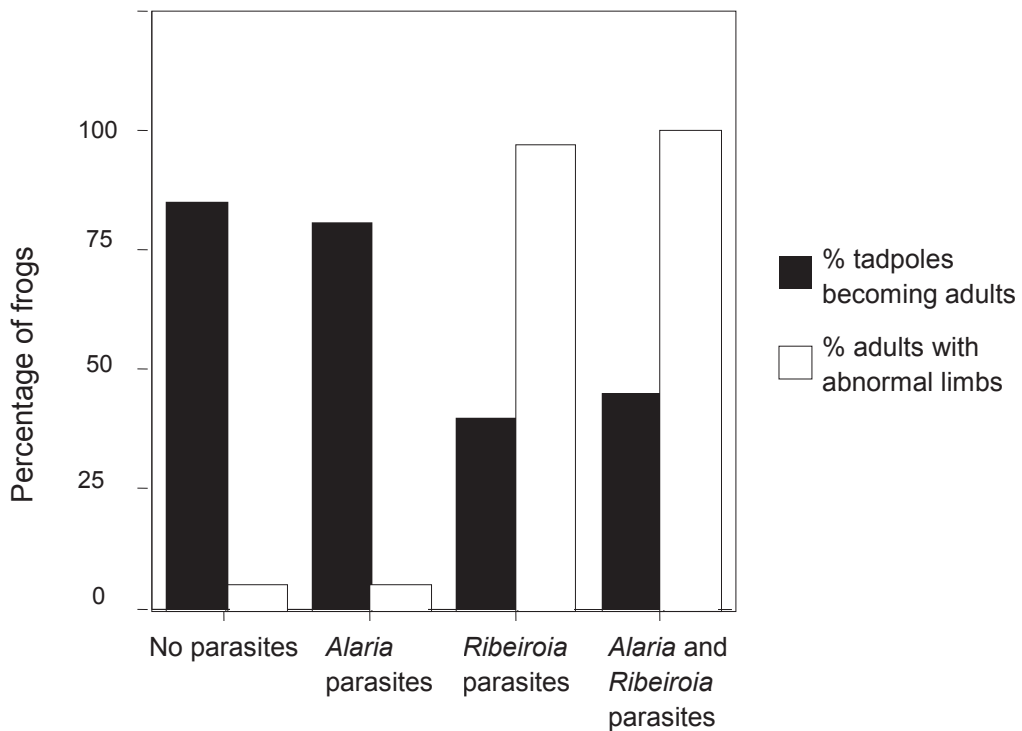
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Questions 4 and 5 refer to the information below.

American biologists found large numbers of Pacific tree frogs with deformed limbs in ponds infected with the parasites *Ribeiroia* and *Alaria*. To test whether infection with *Ribeiroia* and/or *Alaria* caused the deformity, they collected 400 eggs of frogs that had never been exposed to *Ribeiroia* or *Alaria*. They hatched the eggs and then divided the tadpoles into four equal groups and reared each group in different aquaria. One group was reared without *Ribeiroia* or *Alaria*, one with *Alaria* only, one with *Ribeiroia* only and one with both *Ribeiroia* and *Alaria*. The biologists recorded the percentage of tadpoles in each group that survived to become adults and the percentage of the adults that had deformed limbs. The results are shown in the graph below.

Percentage of tadpoles becoming adult frogs and percentage of adult frogs with abnormal limbs when infected with common parasites



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4. What was the independent variable in the experiment?
- (a) the type of parasite present
 - (b) the percentage of tadpoles that became adults
 - (c) the percentage of frogs with deformed limbs
 - (d) the number of tadpoles in each group
5. What is the **best** conclusion from this experiment?
- (a) *Alaria* and *Ribeiroia* both cause limb deformities in Pacific tree frogs.
 - (b) *Ribeiroia* is a major cause of limb deformities in Pacific tree frogs.
 - (c) Pacific tree frogs with limb deformities are more likely to survive to adulthood.
 - (d) Killing parasites will prevent limb deformities in Pacific tree frogs.
6. The enzyme DNA polymerase
- (a) unwinds DNA by breaking the bonds between base pairs.
 - (b) breaks DNA up into separate nucleotides.
 - (c) adds nucleotides to a newly-forming DNA strand.
 - (d) cuts DNA at specific recognition sites.
7. A student breeds fruit flies with red eyes for 20 generations. Suddenly, in the 21st generation, she discovers three white-eyed flies in the culture. Which of the following statements is the most likely explanation of the observation?
- (a) The flies have adapted to the pale food in the culture jars.
 - (b) A mutation has occurred.
 - (c) The white-eyed gene has reappeared after skipping generations.
 - (d) At least two genes are responsible for eye colour in fruit flies.

Questions 8 and 9 refer to the information below.

In the technique of genetic profiling, each DNA profile represents several loci (gene positions) on a pair of homologous chromosomes. If an animal is heterozygous at a particular locus, two bands are seen in the DNA profile. If it is homozygous, only one band is seen.

DNA profiles for three animals are shown below.

Locus	Allele	Animal 1	Animal 2	Animal 3
A	1	-----		
	2		-----	
	3		-----	
	4	-----		-----
	5			-----
B	1			
	2		-----	
	3	-----		
	4	-----	-----	-----
	5			-----
C	1			-----
	2			-----
	3	-----		
	4		-----	
	5			
D	1	-----		
	2		-----	
	3		-----	
	4			-----
	5	-----		
E	1			
	2	-----	-----	
	3			-----
	4		-----	-----
	5			

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8. At how many loci is Animal 2 homozygous?
- (a) 1
 - (b) 2
 - (c) 3
 - (d) 4
9. If Animal 1 mated with Animal 3 and produced a single offspring, the offspring
- (a) must be homozygous at Locus A.
 - (b) may be homozygous at Locus D.
 - (c) could be either homozygous or heterozygous at Locus C.
 - (d) must be heterozygous at Locus E.
10. Which one of the following statements about evidence for evolution is correct?
- (a) The embryos of both humans and fish have tails.
 - (b) The wings of insects and birds are homologous.
 - (c) Organisms produce hundreds of different types of amino acid.
 - (d) Soft-bodied organisms are common in the fossil record.
11. One form of comparative study in biochemistry is the study of proteins. Proteins can be compared to establish how recent is the common ancestry between two species.
- Which of the following would show species with more recent common ancestry?
- Species with a more similar
- (a) sequence of amino acids in a protein.
 - (b) sequence of nucleotides in a protein.
 - (c) shape of a protein molecule.
 - (d) number of amino acids in a protein.
12. Which one of the following most probably evolved through sexual selection?
- (a) antibiotic resistance in bacteria
 - (b) courtship displays in birds
 - (c) high reproduction rates in marine fish
 - (d) milk yields in dairy cows.
13. Animal diseases that can be transmitted to humans are termed
- (a) zoopathogens.
 - (b) zoosporangium.
 - (c) zoospores.
 - (d) zoonoses.

14. An infectious micro-organism has the following characteristics:

- heterotrophic
- cell wall
- genetic material **not** bound by a membrane.

This organism would be a

- (a) protozoan.
 - (b) fungus.
 - (c) virus.
 - (d) bacteria.
15. Which of the following is more likely to occur in small populations than in large populations?
- (a) competition for mates
 - (b) natural selection
 - (c) genetic diversity
 - (d) genetic drift
16. Some chemical companies have joined with biotechnologists to produce genetically-modified crop varieties that have complete resistance to their particular brand of chemical herbicides. This allows farmers to spray their crops to kill all the weeds without harming the crop species. This is very efficient and gives large increases in crop yield. From a biological point of view, a major concern would be that
- (a) weed species are an important part of the ecosystem and should not be killed.
 - (b) most farmers would grow the new varieties, risking loss of genetic diversity.
 - (c) it is unnatural to maintain only one species of plant in an area.
 - (d) some weeds are needed to assist in pollinating a crop.

Questions 17 and 18 refer to the information below.

A lizard was placed in a heated trough until its body reached a steady temperature. It was then transferred to a ventilated container at a lower temperature. The time was recorded for its temperature to fall to within 3° of the container temperature. This procedure was repeated several times with the same lizard at a number of different temperatures.

The results are shown below.

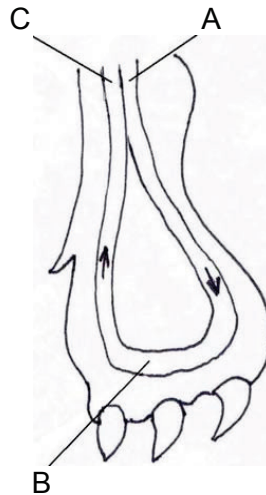
Investigation of lizard temperature versus ambient temperature

Experiment	Trough temperature (°C)	Lizard's temperature after being in trough (°C)	Container temperature (°C)	Lizard's temperature after being in container (°C)	Time for temperature to change (minutes)
P	30	32	10	13	20
Q	40	42	15	18	35
R	50	52	10	13	20
S	60	62	15	18	25

17. In which experiment did the lizard lose the most heat?
- (a) Experiment P
 - (b) Experiment Q
 - (c) Experiment R
 - (d) Experiment S
18. Which experiment shows the most rapid heat loss?
- (a) Experiment P
 - (b) Experiment Q
 - (c) Experiment R
 - (d) Experiment S
19. Homeostasis is the ability of an organism to maintain constant internal conditions in a fluctuating environment. Which of the following statements best illustrates homeostasis?
- (a) When a mammal's blood salt concentration increases, its kidneys excrete more salt.
 - (b) The desert hopping mouse rarely drinks water as it gains enough from other sources.
 - (c) Humans feel dizzy and lose their balance if the oxygen in their blood decreases.
 - (d) The surface area to volume ratio of animals increases as their body size falls.

Question 20 refers to the diagram below.

20. Counter-current heat exchangers are found in the limbs of some birds and mammals living in cold environments. Warmer blood pumped to the extremities is cooled by colder blood returning to the heart, thus minimising heat loss from the extremities.



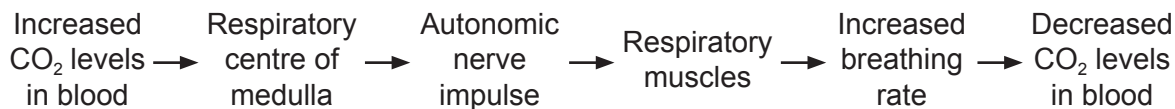
The blood temperatures ($^{\circ}\text{C}$) at A, B and C respectively, are likely to be

	A	B	C
(a)	34	5	22
(b)	22	5	34
(c)	34	22	5
(d)	22	34	5

21. The perentie is a monitor lizard found in the desert regions of Australia. It lives in a dry and hot environment, so it needs to conserve water. One way in which it does this is to excrete its nitrogenous waste in the form of uric acid rather than urea or ammonia. The main reason for this is that uric acid is the
- (a) most soluble in water and least toxic.
 - (b) most soluble in water and most toxic.
 - (c) least soluble in water and most toxic.
 - (d) least soluble in water and least toxic.

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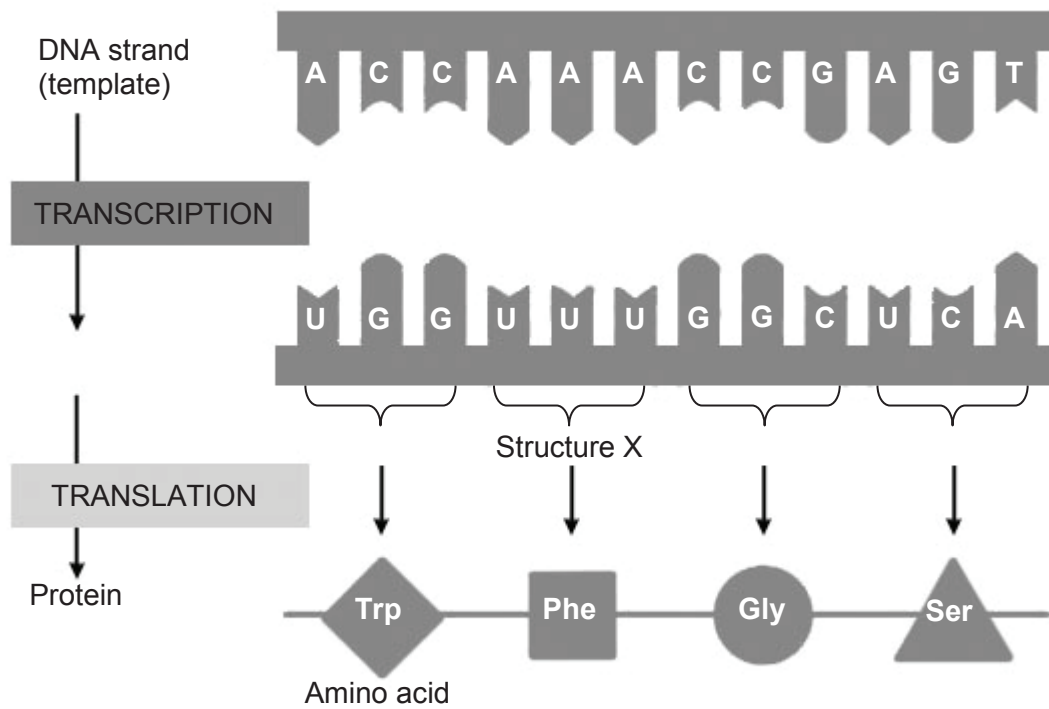
22. Part of a sequence of steps that occurs after an increase in the levels of carbon dioxide in the blood of a mammal is shown in the diagram below.



This sequence is an example of

- (a) positive feedback, as it involves the autonomic nervous system.
 - (b) positive feedback, as it involves an increase in the levels of carbon dioxide.
 - (c) negative feedback, as it involves an effect that is opposite to the stimulus.
 - (d) negative feedback, as it involves changes in carbon dioxide levels and breathing rate.
23. Many seabirds are able to drink sea water because they have glands near the tops of their beaks that excrete salt solution. If sea water contains 35 grams of salt per litre, the concentration of salt excreted from the glands is
- (a) less than 35 g/L.
 - (b) equal to 35 g/L.
 - (c) more than 35 g/L.
 - (d) dependent on the amount of sea water the bird drinks.
24. The most commonly reported mosquito-transmitted disease in Australia is the Ross River virus disease, which occurs throughout Australia. Health departments produce pamphlets that advise people on actions to reduce the number of mosquitoes in their environments.
- The advice is likely to include directions to
- (a) keep swimming pools free of chlorine.
 - (b) stock any garden pool with fish that eat mosquito larvae.
 - (c) keep windows and doors open and uncovered to allow airflow.
 - (d) keep well away from animals that may have been bitten by mosquitoes.

Question 25 and 26 refer to the diagram below, which represents protein synthesis.



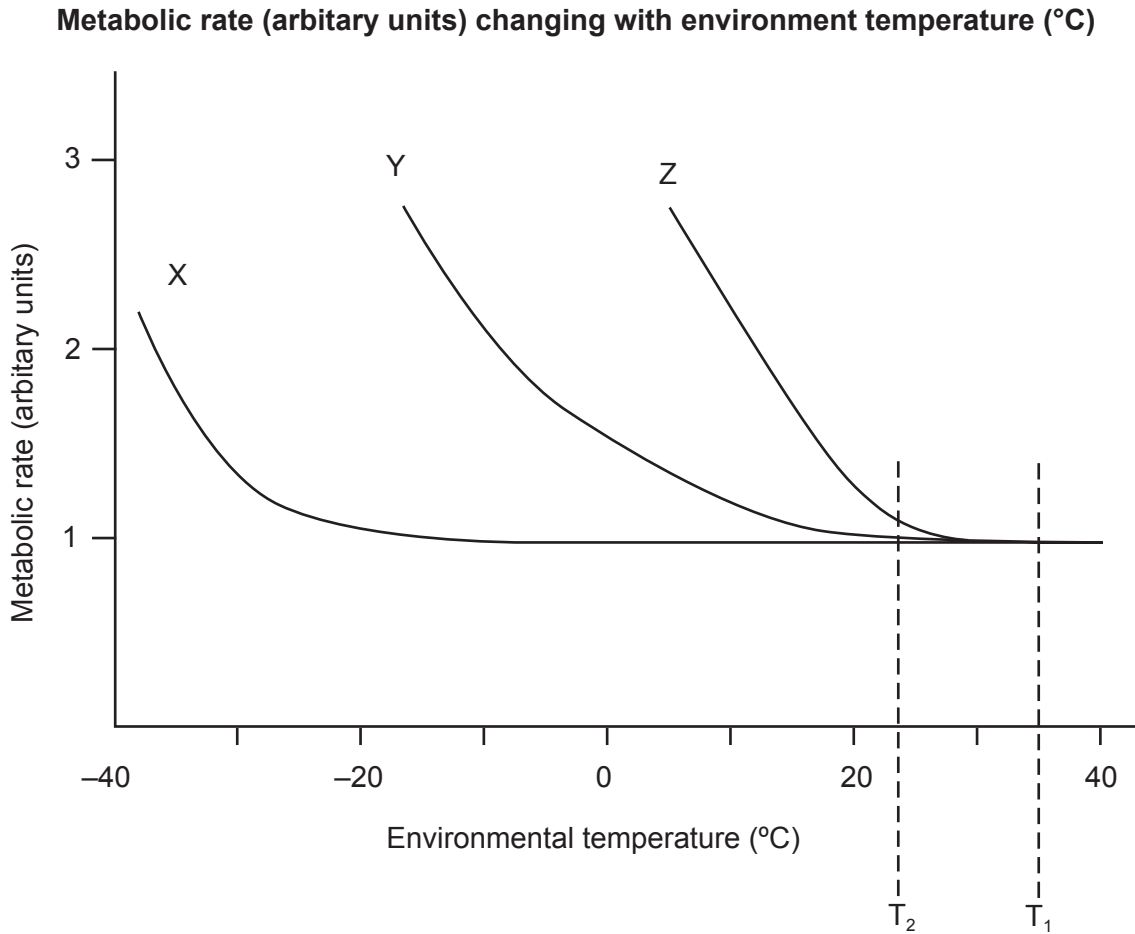
25. Where in the cell does the transcription stage of the process occur?
- (a) ribosomes
 - (b) cytoplasm
 - (c) nucleus
 - (d) mitochondria
26. During the translation stage, structure X binds with another structure to determine the type of amino acid formed.

Which of the following names structure X and the structure that binds to it correctly?

	Structure X	Structure that binds to structure X
(a)	codon of mRNA	anticodon of tRNA
(b)	anticodon of mRNA	codon of tRNA
(c)	codon of tRNA	anticodon of mRNA
(d)	anticodon of tRNA	codon of mRNA

See next page

Question 27 refers to the graph below.



27. Use this graph and your knowledge of thermoregulation to determine which one of the following statements is correct.
- Animal X would be better adapted to a cold environment than Animal Z.
 - Animal X has a poorly-developed mechanism for responding to temperature changes.
 - At temperature T_1 the heat gain of Animal Y is less than its heat loss.
 - Heat production by Animal Z decreases at temperatures below T_2 .
28. Scientists have been researching the spread of a bacterial infection and an infection caused by a protozoan in a population of organisms. In their research, they have examined the growth in the population of these two infectious diseases. You would expect that their data would show that
- both diseases will spread at the same rate.
 - the faster-spreading disease would be that caused by the protozoan.
 - the faster-spreading disease would be that caused by the bacterium.
 - neither would spread, as bacterial and protozoan infections remain in one organism.

See next page

29. Which of the following factors is responsible for an emerging viral disease developing into a threat?
- (a) mild illness is caused in large numbers of people
 - (b) the disease can be treated with a number of drugs
 - (c) the virus is present in high numbers in a local area
 - (d) the virus has the potential to spread beyond outbreak site

30. Many insects on isolated oceanic islands are flightless, even though their close mainland relatives retain their wings.

The most likely explanation for the above is that

- (a) there is nowhere for the insects to fly, so the wings were lost.
- (b) insects with wings are more likely to be blown out to sea and die.
- (c) the ancestral insects that reached the islands from the mainland were mutants with no wings.
- (d) many families of insects do not have wings.

End of Section One

See next page

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 the graph may be drawn in pencil.

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 that you are continuing to answer at the top of the page.

Suggested working time: 90 minutes.

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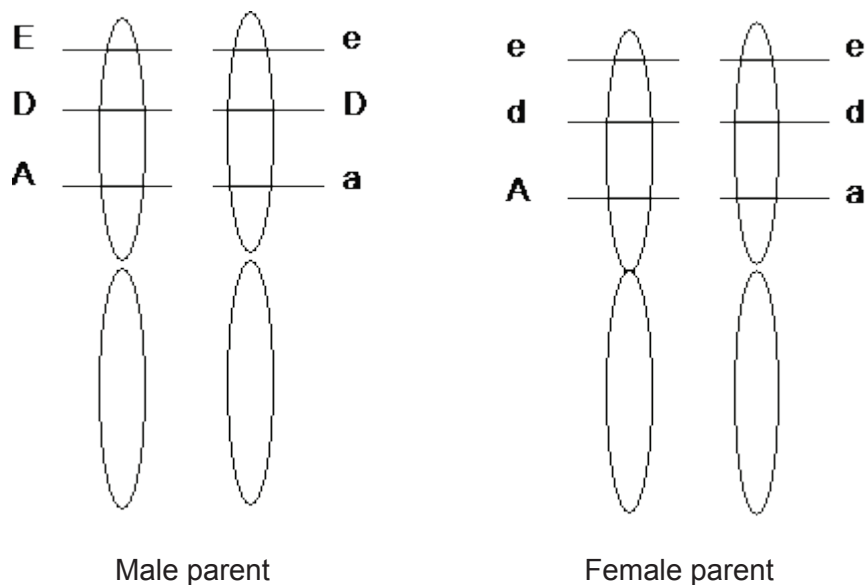
Question 31

(20 marks)

31. A species of mammal has 20 chromosomes in its cells, including 18 autosomal chromosomes plus a pair of sex chromosomes (XX or XY, as in humans). Some of the genes on autosomal chromosome number 1 are shown in the table below.

Characteristic controlled	Alleles
Ear shape	E – ear rounded e – ear pointed
Coat colour	D – coat dark grey d – coat light grey
Eye size	A – eye large a – eye small

The number 1 autosomal chromosomes of a mating pair of this species are shown below.



- (a) (i) List the characteristics for which the male parent is heterozygous. (2 marks)

- (ii) List the characteristics for which the female parent is homozygous. (2 marks)

- (b) Give the probability of an offspring of this pair having pointed ears. Explain your answer, showing your working. (4 marks)

- (c) (i) Describe the phenotype of the male parent for all characteristics. (2 marks)

- (ii) Describe the phenotype of the female parent for all characteristics. (2 marks)

- (d) Is it possible that the male parent's mother had a light-grey coat? Explain your answer, showing your working. (4 marks)

- (e) What is the probability that the first offspring of this pair is a female with rounded ears and a dark coat? Show your working. (4 marks)

Question 32

(20 marks)

Many species of bats, particularly those that live in colder climates, have body temperatures that fall when they are inactive. Their resting body temperature is almost as low as their surroundings. When the bats wake, they cannot fly off immediately. Instead they shiver and pull their body up and down. They then start to flap their wings and eventually take off.

- (a) Explain **two** ways in which periods of inactivity help the bats' survival. (4 marks)

- (b) (i) Explain why these bats, like all other mammals, are considered to be endothermic despite their low resting body temperature while inactive. (2 marks)

- (ii) Why are bats **not** considered to be ectothermic? (2 marks)

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- (c) In some species of bats, periods of inactivity can last for several months. During a period of inactivity, they must waken occasionally to drink water and urinate. Reptiles in the same environment do not wake at all. Explain how differences in the excretion of nitrogenous wastes between mammals and reptiles might help to account for these observations. (4 marks)

- (d) While they are inactive and beginning to warm up, the bats' wings are folded against their bodies. Explain **two** reasons why this is an advantage for the bats. (4 marks)

- (e) During awakening, the bats' metabolic rates increase to above normal levels. In terms of the stimulus response feedback model of temperature regulation, explain why their body temperature does **not** rise above normal levels. (4 marks)

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Question 33

(20 marks)

Jarrah dieback is a devastating disease that affects many Western Australian plants.

- (a) (i) Name the organism that causes this disease. (1 mark)

- (ii) Describe how this organism is transmitted naturally through an ecosystem. (1 mark)

- (iii) List **two** ways in which humans transmit this organism into ecosystems. (2 marks)

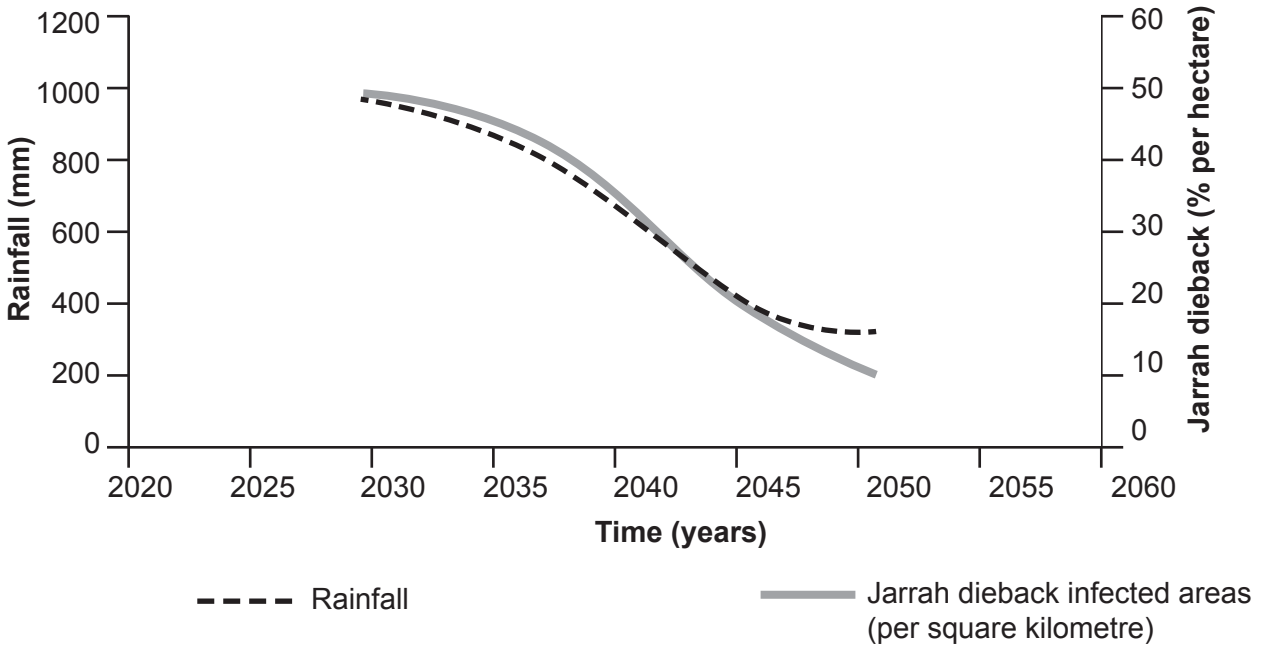
- (b) (i) Describe how plants that are located in a jarrah dieback area are treated to assist their survival. (2 marks)

- (ii) Name and describe **two** human management practices that are carried out to prevent the spread of jarrah dieback. (4 marks)

Historical and current climate data are used by computers to model predicted future rainfall. These predictions are then used to model possible infection rates of diseases in many environments.

The following graph predicts the future rainfall and levels of jarrah dieback in the Dandaragan woodlands, an area 200 kilometres north of Perth.

Predicted jarrah dieback compared to rainfall in Dandaragan woodlands



(c) Using the graph, explain the effect of rainfall on jarrah dieback in the Dandaragan woodlands. (3 marks)

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Question 33 (continued)

Crown gall is another infectious disease found in plants.

- (d) (i) Name the organism that causes this infection. (1 mark)

- (ii) Describe how this organism is different from the type of organism that causes jarrah dieback. (2 marks)

- (e) Explain the method used by this pathogen to invade the host plant and the impact of the pathogen on the plant. (4 marks)

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Question 34

(20 marks)

Genetic recombination in eukaryotes occurs via several processes, including crossing over and independent assortment of chromosomes during meiosis.

(a) Describe each of these processes and explain briefly how they produce genetic variation.

(i) Crossing over (2 marks)

(ii) Independent assortment (2 marks)

(b) Humans have used artificial selection (selective breeding) to modify the characteristics of plants and animals for many years. Outline how artificial selection can be used to increase drought resistance in rice. (4 marks)

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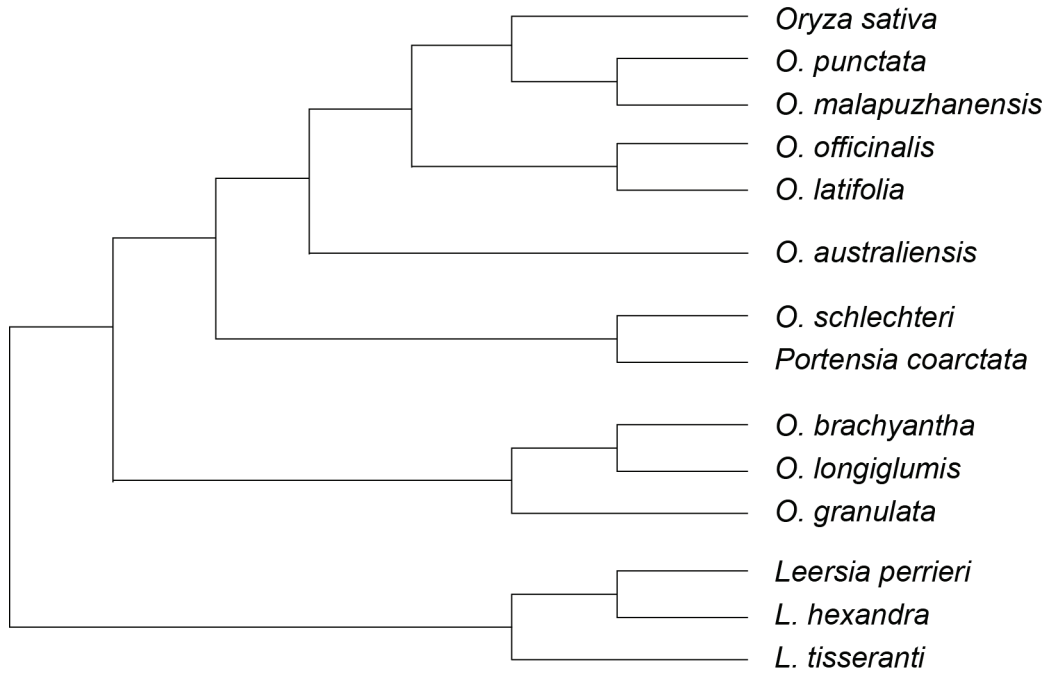
Question 34 (continued)

- (c) Humans are now using recombinant DNA technology to modify the characteristics of plants and animals. Outline how recombinant DNA technology can be used to increase drought resistance in rice. (4 marks)

- (d) Describe **two** advantages and **two** disadvantages of using recombinant DNA technology instead of artificial selection to modify the characteristics of plants and animals. (4 marks)

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- (e) The Asian rice plant is a member of the genus *Oryza*, which also includes a number of species of wild rice. The following phylogenetic tree shows the evolutionary relationships between the Asian rice (*O. sativa*) and some of the wild species in the *Oryza* and other related genera.



- (i) On the basis of the information contained in the phylogenetic tree, is Asian rice related more closely to *O. australiensis* or *O. officinalis*? Explain your answer. (2 marks)

- (ii) Some scientists have argued that *Portensia coarctata* should be regarded as a member of the *Oryza* rather than as a separate genus. Does the phylogenetic tree support this argument? Explain your answer. (2 marks)

Question 35

(20 marks)

A group of fish farmers growing barramundi in ocean cages in the Kimberley region of Western Australia wanted to minimise their impact on the marine environment by reducing the amount of fish food that was not eaten and therefore floated out of the cages. At the same time, they wanted to ensure that there was no corresponding reduction in the size of the fish they were growing.

They were also interested in finding out whether using fish stock originally from the coastal areas of New South Wales would make a difference to the growth rate. They imported some barramundi stock from Port Stephens in New South Wales and compared them with the existing Kimberley stock of barramundi.

Trials were conducted by placing one hundred Kimberley barramundi in each of four separate sea cages and feeding them a measured quantity of fish feed. The increase in their mass as measured by percentage increase was recorded three months later. This procedure was repeated with barramundi from Port Stephens. The results obtained from these trials are presented in the table below.

**Change in mass of Kimberley and Port Stephens barramundi
fed different amounts of feed**

Sea cage	Mass of fish feed (grams/fish/day)	Average per cent increase in mass of fish	
		Kimberley barramundi	Port Stephens barramundi
1	10	8	4
2	20	17	7
3	30	25	12
4	40	25	24

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

- (b) (i) State the independent variable. (1 mark)

- (ii) State the dependent variable. (1 mark)

- (iii) Apart from those mentioned above, name **two** variables that would need to be controlled to ensure the experiment was reliable. (2 marks)

See next page

(c) (i) What conclusion could be drawn from the data? (2 marks)

(ii) Explain whether the sample size was appropriate for this investigation. (2 marks)

(d) Describe **two** ways in which the data collected in this investigation could be made more reliable. (4 marks)

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Question 35 (continued)

A group of Port Stephens barramundi farmers conducted a similar trial. The table below shows the average mass of the fish before and after the feeding trials.

Change in mass of Port Stephens barramundi fed different amounts of feed

Sea cage	Mass of fish feed (grams/fish/day)	Average mass of fish (kilograms)	
		Before feeding trials	After feeding trials
A	10	1.60	1.45
B	20	1.70	1.80
C	30	1.65	2.20
D	40	1.60	2.75

- (e) What was the percentage change in the mass of the fish in Sea Cage C? Show your workings clearly. (2 marks)

- (f) The Port Stephens barramundi stock showed an average increase in mass when fed 10 grams/fish/day in the Kimberley, but lost mass in the Port Stephens trials. Explain **two** possible reasons for this difference. (4 marks)

End of Section Two

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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 or ballpoint for written answers and pencil for diagrams. Crossing out of incorrect material is acceptable and preferable to using correction fluid/tape.

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.

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Suggested working time: 50 minutes.

Unit 3: Choose either Question 36 or Question 37.**(20 marks)**

Indicate the question you will answer by ticking the box next to the question. Write your answers on pages 32–36. When you have answered your first question, turn to page 37 and indicate the second question you will answer on that page.

Question 36**(20 marks)**

The use of genetically-modified canola in the Western Australian wheatbelt has been a source of contention between proponents and opponents. Genetically-modified canola has been produced that is resistant to one of the most commonly used herbicides. One of the concerns raised has been the potential for the emergence of 'super weeds' (weeds that are extremely resistant to herbicides) and consequences for remnants of natural ecosystems.

- (a) Describe the process that could lead to a few initial super weeds potentially becoming the dominant type of weed in the wheatbelt. (10 marks)

The remnants of natural ecosystems in the wheatbelt are managed to maintain their biodiversity. Management includes spot spraying of weeds. Super weeds not affected by the spraying may become established in large numbers.

- (b) Explain the consequences of the establishment of super weeds for organisms living in the natural ecosystem. (10 marks)

See next page

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

Zoos run international breeding programs in which they pair particular males and females to maintain genetic diversity. In some situations, there is a need to introduce some 'wild stock', i.e. animals from the wild, into the breeding programs. Often there are one or two particular genes that zoos are interested in. In determining which individual to use, zoos rely on hair samples.

- (a) Explain the processes which could be performed on the hair sample to determine whether an animal would be genetically useful. (10 marks)

The Tasmanian devil (*Sarcophilus harrisii*) was placed on the endangered list in 2008 because of a population decline due to devil facial tumour disease (DFTD), a rare type of infectious cancer in which facial tumours grow very rapidly on the face or inside the mouth of affected devils. Death usually occurs within months of the appearance of initial symptoms. One of the conservation approaches has been the formation of large fenced areas in which disease-free devils can roam free and form self-sustaining populations.

- (b) Explain the characteristics of a viable population and the role of biogeography, reproductive behaviour and population dynamics in maintaining a viable gene pool in an artificially-selected area. (10 marks)

Unit 4: Choose either Question 38 or Question 39.

(20 marks)

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

Question 38

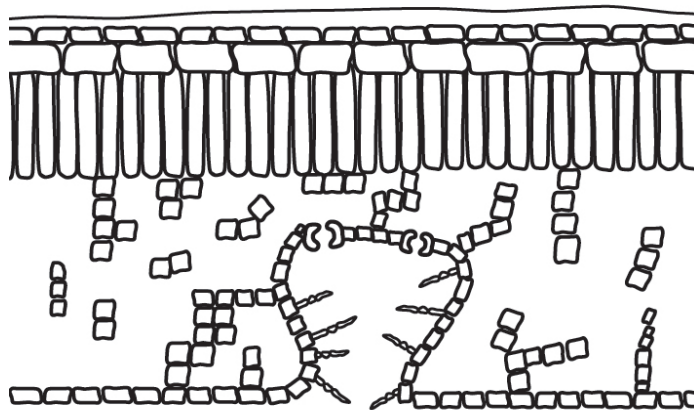
- (a) Describe malaria and Ross River fever with reference to the type of organism that causes the disease, the intermediate host, mode of transmission and impact on the host. (10 marks)

'The incidence of malaria and Ross River fever may be affected by global climate change.'

- (b) Explain this statement with reference to changes in the spread of these infectious diseases. (10 marks)

Question 39

Examine the following diagram of the internal structure of a leaf of a plant that is adapted to a particular environment.



- (a) Explain **five** features that plants adapted to this environment may possess. (10 marks)

Like plants, animals require adaptations to survive in their specific environments. Freshwater and marine vertebrates experience different salt conditions in their environments.

- (b) Describe the problems these vertebrates face in maintaining water balance and how they overcome these problems in each water environment. (10 marks)

End of questions

ACKNOWLEDGEMENTS

Section One

Questions 4–5 Diagram from: Sadava, D., Heller, H.C., Orians, G.H., Purves, W.K., & Hillis, D.M. (2008). *Life: The science of biology*. (8th ed). Sunderland, MA: Sinauer Associates, p.15.

Data source: Sadava, D., Heller, H.C., Orians, G.H., Purves, W.K., & Hillis, D.M. (2008). *Life: The science of biology*. (8th ed). Sunderland, MA: Sinauer Associates, p.15.

Section Two

Question 33 Adapted from: Allison, T. (2010). *Haplotype analysis of sickle-cell trait*. Retrieved October, 2013, from Wikipedia website http://en.wikipedia.org/wiki/File:Haplotype_analysis_of_sickle-cell_trait.png.

Question 34(e) Adapted from: Ge, S., Li, A., Lu, B.-R., Zhang, S.-Z., & Hong, D.-Y. (2002). A phylogeny of the rice tribe Oryzeae (Poaceae) based on MATK sequence data (Figure 1). *American Journal of Botany*, 89(12), pp. 1967-1972. Used with permission of the Botanical Society of America.

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