Government of **Western Australia**
School Curriculum and Standards Authority

WACE
Western Australian Certificate of Education

Western Australian Certificate of Education Examination, 2014

Question/Answer Booklet

BIOLOGICAL SCIENCES

Stage 3

Place one of your candidate identification labels in this box.

Ensure the label is straight and within the lines of this box.

Student Number: In figures | | | | | | | | | |

In words _____

_____

Number of additional answer booklets used (if applicable):

Time allowed for this paper

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

Materials required/recommended for this paper

To be provided by the supervisor

This Question/Answer Booklet
Multiple-choice Answer Sheet

To be provided by the candidate

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

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

Important note to candidates

No other items may be taken into the examination room. It is **your** responsibility to ensure that you do not have 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.

Ref: 14-015
BIO3

TRIM 2014/50244
Web version of 2014/41729

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 Part A	3	2	50	40	20
Part B	3	2			
				Total	100

Instructions to candidates

1. The rules for the conduct of Western Australian external examinations are detailed in the *Year 12 Information Handbook 2014*. Sitting this examination implies that you agree to abide by these rules.

2. 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 for this section. Only graphs and diagrams may be drawn in pencil.

   Section Three consists of two parts each with three questions. You must answer **two** questions from **each** part. 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 and drawing annotated flow diagrams with introductory notes.

3. 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.

4. 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.

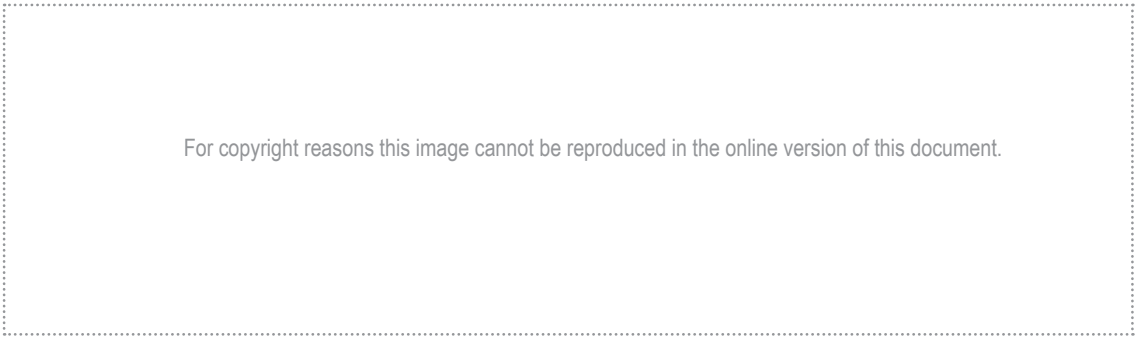
See next page

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. 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.

Question 1 refers to the diagram below, which shows a cell process.



1. This process is

   (a) crossing over.
   (b) DNA replication.
   (c) transcription.
   (d) meiosis.

2. The ethical handling of animals in biology is governed by three principles, often referred to as the '3Rs'. These principles are

   (a) replace, reduce and refine.
   (b) replace, reduce and restrain.
   (c) recycle, reduce and refine.
   (d) recycle, reduce and restrain.

3. A plant that is adapted to a cool, moist environment is **most** likely to have leaves

   (a) with a thick cuticle.
   (b) that are reduced to spikes.
   (c) that are covered in hairs.
   (d) with many stomata.

4. A eukaryotic cell will have more

   (a) chromosomes than genes.
   (b) chromosomes than alleles.
   (c) alleles than genes.
   (d) genes than alleles.

See next page

5. A freshwater diatom (single-celled alga) that is placed in a tank of seawater will

(a) swell because it is hypotonic to the seawater.
(b) shrivel because it is hypotonic to the seawater.
(c) swell because it is hypertonic to the seawater.
(d) shrivel because it is hypertonic to the seawater.

6. Seed banks generally store seeds

(a) at the location the seeds were collected.
(b) at the location the seeds will be planted.
(c) in low humidity conditions.
(d) in high humidity conditions.

Questions 7 and 8 refer to the table below.

A biologist calculated the average germination (%) of seeds from six species after the seeds had been stored for 5–10 years and for 15–18 years in a seed bank. The results are shown in the table below.

	Average germination of seeds (%)	
Species	**5–10 years**	**15–18 years**
Acacia chrysotricha	92	74
Acacia gordonii	100	82
Eucalyptus benthamii	98	92
Eucalyptus camfeldii	58	36
Hakea dactyloides	100	92
Telopea speciosissima	96	58

7. The seeds of which species had the highest average germination in both time periods?

(a) *Hakea dactyloides*
(b) *Eucalyptus benthamii*
(c) *Acacia gordonii*
(d) *Acacia chrysotricha*

8. Which species showed the largest decline in average germination between the two storage periods?

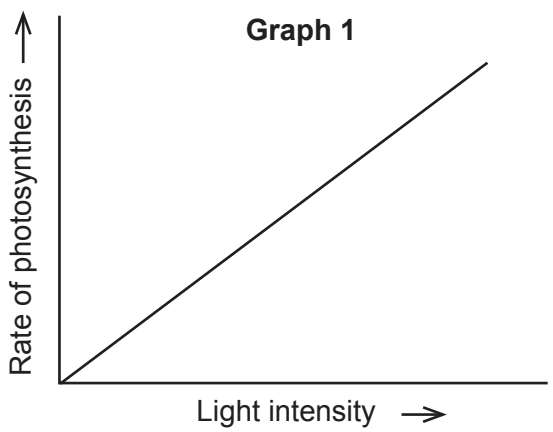
(a) *Acacia chrysotricha*
(b) *Eucalyptus benthamii*
(c) *Eucalyptus camfeldii*
(d) *Telopea speciosissima*

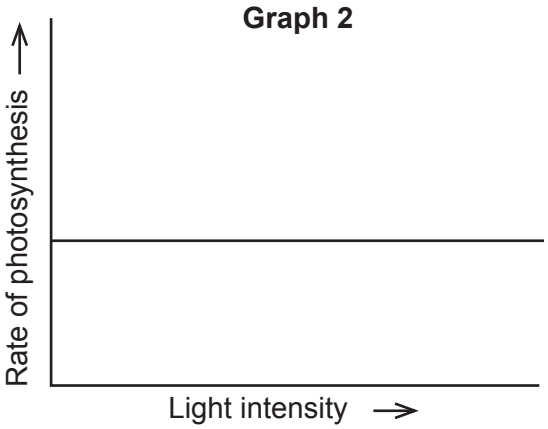
9. In a chloroplast, the

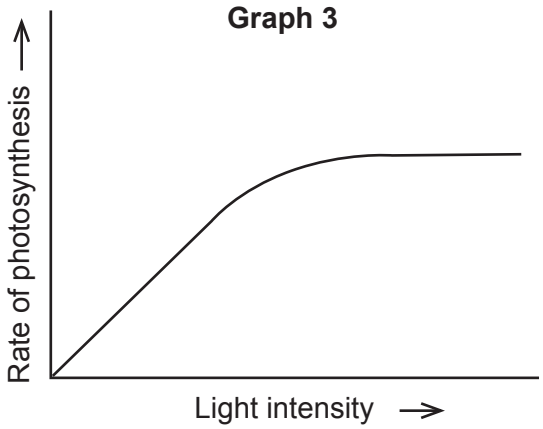
(a) light-dependent reactions occur in the stroma and produce hydrogen ions.
(b) light-dependent reactions occur in the grana and produce oxygen.
(c) light-independent reactions occur in the stroma and produce hydrogen ions.
(d) light-independent reactions occur in the grana and produce oxygen.

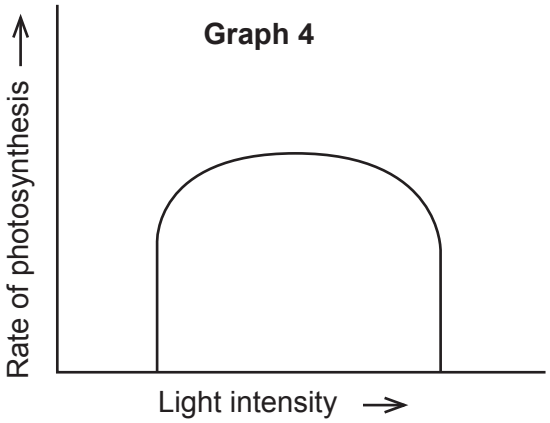
See next page

10. Which of following graphs shows the relationship between light intensity and the rate of photosynthesis?









(a) Graph 1
(b) Graph 2
(c) Graph 3
(d) Graph 4

11. Translation occurs on or in

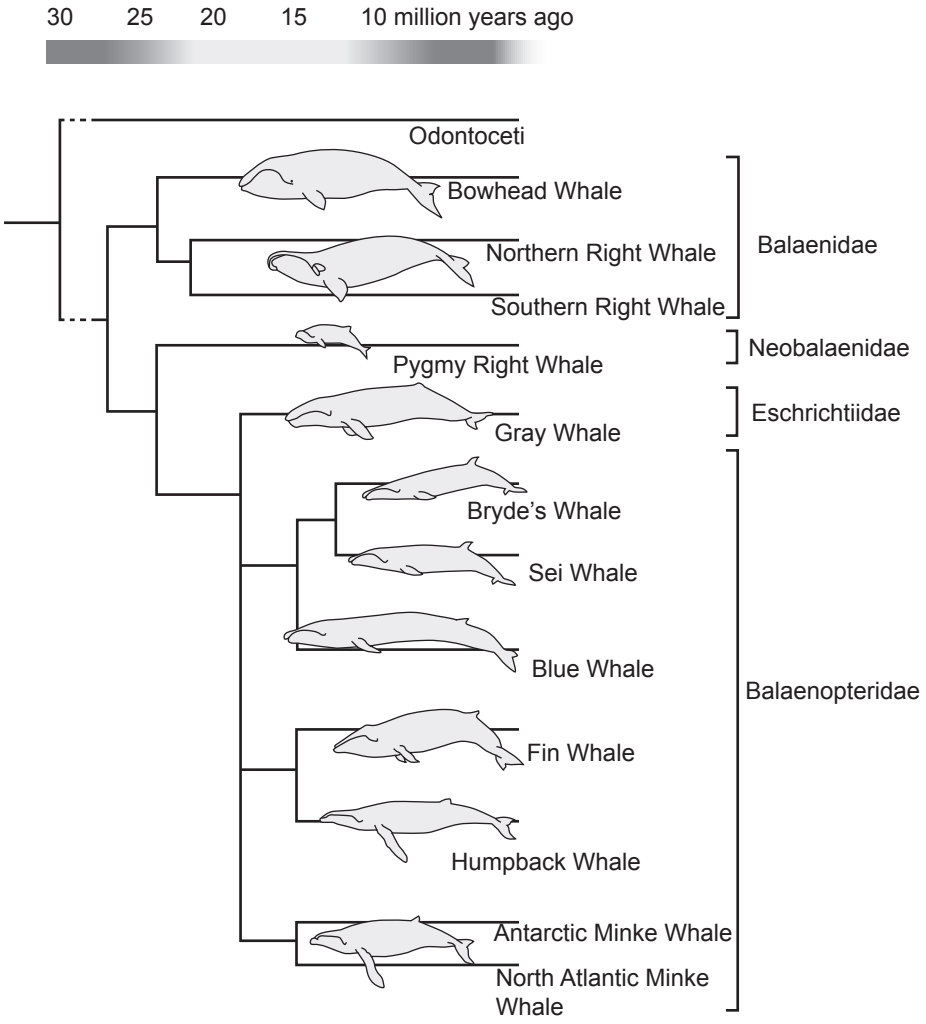
(a) golgi vesicles.
(b) nuclei.
(c) lysosomes.
(d) ribosomes.

12. Dryland salinity in a landscape is caused by the

(a) removal of shallow-rooted plants.
(b) rising groundwater.
(c) falling groundwater.
(d) erosion of topsoil.

See next page

Questions 13 and 14 relate to the following phylogenetic tree, which shows the relationships among some whale species.



13. On the basis of the information contained in the phylogenetic tree, which of the following pairs of whale species are **most** closely related?

    (a) Sei Whale and Bryde's Whale
    (b) Blue Whale and Fin Whale
    (c) Bowhead Whale and Humpback Whale
    (d) Pygmy Right Whale and Northern Right Whale

14. Approximately how long ago did the Antarctic Minke Whale and North Atlantic Minke Whale diverge?

    (a) 30 million years ago
    (b) 20 million years ago
    (c) 15 million years ago
    (d) 10 million years ago

See next page

15. Biodiversity is generally studied at three levels. The ‘species’ is one of these levels. The other two are

(a) genetics and ecosystems.
(b) communities and populations.
(c) cells and chromosomes.
(d) individuals and biomes.

Question 16 refers to the image below.

16. In the hottest parts of the day, lizards stand so that their bodies do not touch the rocks they are standing on. This assists the lizards to

(a) increase heat loss by convection and conduction.
(b) decrease heat gain by convection and conduction.
(c) decrease heat gain by convection and increase heat loss by conduction.
(d) increase heat loss by convection and decrease heat gain by conduction.

17. Which of the following processes describes the exchanges of alleles between homologous chromosomes?

(a) mutation
(b) independent assortment
(c) crossing over
(d) random mating

18. A biologist kept a culture of vinegar flies in the laboratory. The biologist only allowed those flies with a relatively large number of bristles on their abdomen to breed. He did this for several generations and at the end of the study found that, on average, the number of abdominal bristles in the vinegar flies in the culture had increased. The increase in the number of abdominal bristles in the flies was due to

(a) natural selection.
(b) artificial selection.
(c) gene flow.
(d) genetic drift.

See next page

19. A biologist wanted to estimate the density of the plant *Hibbertia cuneiformes* in a study area of 1000 m^2. The biologist counted all of the individuals of this species in two transects. Each transect was 1 m wide by 250 m long. Seventy individuals of *Hibbertia cuneiformes* were counted. On the basis of these data, the best estimate of the density of *Hibbertia cuneiformes* in the study area is

(a) 70 plants.
(b) 140 plants.
(c) 0.07 plants/m^2.
(d) 0.14 plants/m^2.

20. Nuisance blooms of algae in coastal regions are likely to be due to

(a) eutrophication.
(b) biomagnification.
(c) overharvesting.
(d) revegetation.

21. A fish in freshwater

(a) actively secretes salts via the gills.
(b) produces large amounts of dilute urine.
(c) actively pumps ions out of its cells.
(d) drinks large volumes of water.

22. The sequence of bases in a strand of DNA is ATCGAGC. The sequence of bases in a mRNA molecule synthesised from this strand will be

(a) ATCGAGC.
(b) TAGCTCG.
(c) UAGCUCG.
(d) TUCGAGC.

23. In the cell membrane, facilitated diffusion transports

(a) oxygen across the phospholipid bilayer.
(b) glucose across the phospholipid bilayer.
(c) oxygen through protein channels.
(d) glucose through protein channels.

24. A major difference between facilitated and simple diffusion is that

(a) facilitated diffusion uses energy, whereas simple diffusion does not.
(b) simple diffusion uses energy, whereas facilitated diffusion does not.
(c) facilitated diffusion is more rapid than simple diffusion.
(d) simple diffusion is more rapid than facilitated diffusion.

See next page

Questions 25 and 26 relate to the following information.

A group of biology students conducted an experiment to investigate how different environmental conditions affected the amount of water used by a plant. The students used a potometer to measure the cumulative amount of water used (in millilitres) by a twig from the plant over a 12 minute period. A different twig was used in each condition. Readings of the cumulative amount of water used were taken every two minutes. The results are shown in the table below.

Cumulative amount of water used (millilitres)

	Time (minutes)					
Environmental Condition	2	4	6	8	10	12
Normal room	0	0	1.0	1.6	2.3	3.1
Humid	0	0	0	1.0	1.8	2.1
Bright light	1.8	2.6	3.3	5.7	6.2	7.3
Wind	4.1	5.2	7.1	9.3	10.4	12.1

25. The average rate of water used by the twig in normal room conditions was about

(a) 0.52 ml/min.
(b) 0.26 ml/min.
(c) 0.66 ml/min
(d) 3.10 ml/min.

26. The reliability of the experiment could be improved by using

(a) more twigs.
(b) more environmental conditions.
(c) a different potometer.
(d) different experimenters.

27. Polymerase chain reaction (PCR) is an artificial method of

(a) DNA repair.
(b) DNA replication.
(c) transcription.
(d) translation.

Questions 28 and 29 relate to the calculation of the running speed of the extinct dinosaur *Tyrannosaurus rex.*

28. A biologist wanted to calculate the running speed of *Tyrannosaurus rex* but needed to know the dinosaur's foot length to make the calculation. Which of the following types of evidence would provide the best estimate of foot length in *Tyrannosaurus rex*?

(a) comparative anatomy
(b) comparative biochemistry
(c) embryology
(d) fossil

See next page

29. The biologist estimated the maximum speed of *Tyrannosaurus rex* to be 7 metres per second, but wanted to convert the units to kilometres per hour (km/hr) so she could compare the estimate to those for other dinosaur species. The estimate in km/hr is

(a) 0.42.
(b) 2.52.
(c) 25.2.
(d) 42.0.

30. Which of the following statements about homeostatic control mechanisms is correct?

(a) Positive feedback mechanisms are common and enhance the original stimulus.
(b) Positive feedback mechanisms are common and reduce the original stimulus.
(c) Negative feedback mechanisms are common and enhance the original stimulus.
(d) Negative feedback mechanisms are common and reduce the original stimulus.

End of Section One

See next page

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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 graphs and diagrams 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.

Question 31 **(20 marks)**

Through the analysis of polar ice cores, scientists can determine the concentration of carbon dioxide in the atmosphere at different times in the past. One set of data going back 400,000 years is shown in the table below.

Number of years ago	Atmospheric carbon dioxide concentration in parts per million (ppm)
400,000	275
350,000	190
300,000	240
250,000	220
200,000	245
150,000	170
100,000	230
50,000	210
0	285

(a) On the grid provided on page 13, graph these data. (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.

See next page

See next page

Question 31 (continued)

(b) Looking at your graph, is it possible to accurately interpolate data on concentration of carbon dioxide in the atmosphere for times when data have not been recorded? Give a reason for your answer. (2 marks)

(c) Indicate whether each of the following statements about the data is true or false by circling the correct answer. Give a reason for your answer.

(i) The data indicate that the concentration of carbon dioxide in the atmosphere has been increasing for the past 400,000 years. (2 marks)

True False

Reason:

(ii) The data indicate that the concentration of carbon dioxide in the atmosphere is causing global warming (climate change). (2 marks)

True False

Reason:

See next page

(d) Explain how the burning of fossil fuels contributes to global warming (climate change). (4 marks)

(e) Explain how the effects of land clearing and deforestation contribute to global warming (climate change). (4 marks)

See next page

Question 32 **(20 marks)**

(a) Cells come in a wide variety of shapes and sizes.

(i) State a shape that has a high surface area to volume ratio. (1 mark)

(ii) State a shape that has a low surface area to volume ratio. (1 mark)

(iii) Some cells have a high surface area to volume ratio. Describe how a high surface area to volume ratio benefits a cell. (2 marks)

(b) The transport of materials into and out of a cell can be active or passive.

(i) State the main difference between active and passive transport. (2 marks)

(ii) Name **two** types of active transport. (2 marks)

See next page

(c) Cells can respire aerobically or anaerobically.

(i) Where in eukaryotic cells does aerobic respiration take place? (1 mark)

(ii) Where in eukaryotic cells does anaerobic respiration take place? (1 mark)

(iii) State **two** outputs of anaerobic respiration in plants. (2 marks)

(d) Name the energy-storing molecule that is produced by aerobic respiration and describe how this molecule stores and releases energy. (4 marks)

See next page

Question 32 (continued)

(e) Endotherms that live in cold environments have a range of structural adaptations that reduce heat loss. State **one** such structural adaptation and explain how it acts to reduce heat loss. (4 marks)

See next page

Question 33 **(20 marks)**

(a) Complete the following table by ranking urban, agricultural and natural ecosystems from highest to lowest with respect to the four factors listed in the first column. Use '1' to indicate the ecosystem that ranks the highest with respect to a particular factor, '2' to indicate the next highest and '3' to indicate the lowest. As an example, the rankings for stability have been completed for you. (4 marks)

	Ecosystem		
Factor	**Urban**	**Agricultural**	**Natural**
Stability	*3*	*2*	*1*
Fossil fuel input			
Amount of recycling			
Heat output			
Biodiversity			

(b) Explain **two** reasons why natural ecosystems are generally more stable than urban ecosystems.

(4 marks)

See next page

Question 33 (continued)

(c) Fire causes change in natural ecosystems.

(i) State **two** distinctly different advantageous effects that fire can have on natural ecosystems. (2 marks)

(ii) State **two** distinctly different disadvantageous effects that fire can have on natural ecosystems. (2 marks)

(d) Human harvesting of fish from the marine environment has caused a range of changes to marine ecosystems. Describe **two** such changes. (4 marks)

(e) Duck hunting in Australia is managed by having a short open season/long closed season. Explain **two** reasons why the use of open and closed seasons can be an effective tool for the conservation of game (hunted wildlife). (4 marks)

See next page

Question 34 **(20 marks)**

Enderby Island Cattle existed on Enderby Island, south of New Zealand, for over 80 years. This breed of cattle is of interest because of its ability to survive cold conditions. Biologists want to isolate the genes that allow the Enderby Island Cattle to survive in cold conditions and transfer them to other cattle breeds.

(a) (i) What is the term used to describe a species that contains a gene that has been artificially introduced from another species? (1 mark)

(ii) Explain how DNA microarrays can be used to identify the genes that promote cold tolerance in the Enderby Island Cattle. (2 marks)

(iii) DNA microarray technology is relatively new. What is the main advantage of this technology? (1 mark)

(b) A variety of techniques, including restriction enzymes, would be used to transfer a gene from an Enderby Island cow into another cattle breed.

(i) What are restriction enzymes? (2 marks)

See next page

(ii) What role would restriction enzymes play in the process of transferring a gene from one organism to another? (2 marks)

(c) In 1991 it was decided to remove introduced species, including cattle, from Enderby Island to restore the natural ecosystem.

(i) What is an introduced species? (2 marks)

(ii) Explain how the removal of the cattle would help to restore the natural ecosystem. (2 marks)

(d) The population of Enderby Island Cattle on Enderby Island was started from about nine individuals and remained small for the entire time that the cattle were on the island. The allele frequencies in this population are therefore likely to have been changed by genetic drift. Explain how genetic drift changes the allele frequencies in a population. (4 marks)

See next page

Question 34 (continued)

(e) In most cattle breeds the bulls are much larger and more muscular than the cows. Is this likely to be due to natural selection, artificial selection or sexual selection? Explain your answer. (4 marks)

See next page

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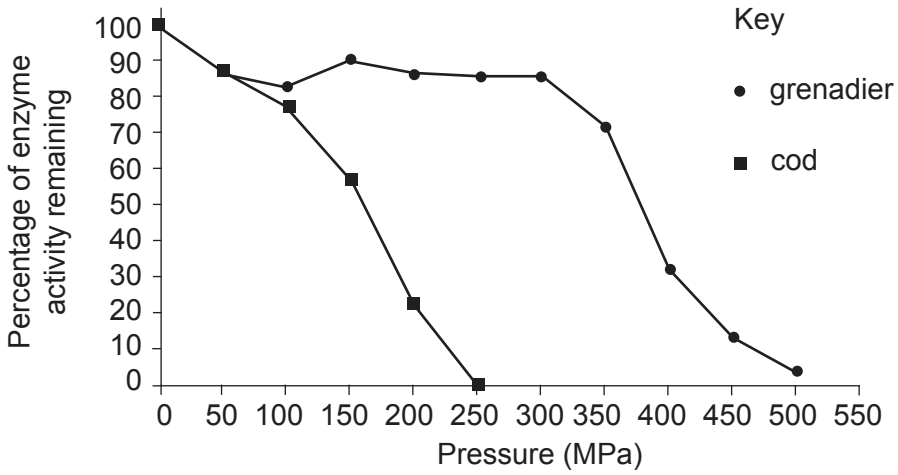
See next page

Question 35 **(20 marks)**

A biologist investigated the relationship between the activity of the lactate dehydrogenase (LDH) enzyme and external pressure in two species of fish (grenadier and cod) in a controlled experiment. The results are shown in the following graph.



(a) (i) State the independent variable in the experiment. Give a reason for your answer. (2 marks)

Independent variable: _____

Reason: _____

(ii) State the dependent variable in the experiment. Give a reason for your answer. (2 marks)

Dependent variable: _____

Reason: _____

(b) The experiment was controlled for the effects of temperature. Explain how temperature affects enzyme activity. (4 marks)

_____

_____

_____

_____

_____

_____

_____

_____

See next page

(c) Sometimes data are presented in a graph and sometimes in a results table. Present the data points for external pressure and enzyme activity in the cod from the graph in a results table. (4 marks)

(d) Compare the relationship between enzyme activity and external pressure in the grenadier and cod. Quote data to support your answer. (4 marks)

See next page

Question 35 (continued)

(e) The composition of the LDH enzymes of the grenadier and cod differ with respect to at least 21 amino acids. Name the evolutionary process that is the source of differences in the amino acid composition of molecules and explain how this process leads to such differences. (4 marks)

End of Section Two

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

Section Three consists of two parts each with three questions. You must answer **two** questions from **each** part.

Part A questions are below and are repeated on page 33.
Part B questions commence on page 37 and are repeated on page 41.

Use black or blue pen for written answers and pencil for diagrams. Crossing out 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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- 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: 50 minutes.

Part A

Answer any **two (2)** questions from Questions 36 to 38. **(20 marks)**

Indicate the first question from Part A you will answer by ticking the box next to the question. Write your answer on pages 30–32. When you have answered your first question, turn to page 33 and indicate the second question you will answer on that page.

☐ **Question 36** **(10 marks)**

Describe the process of biological control and discuss the advantages and disadvantages of biological control as a method of pest control.

☐ **Question 37** **(10 marks)**

Vertebrates excrete three forms of nitrogenous waste. Select **two** of these and, in each case, name the form of nitrogenous waste and discuss its characteristics in relation to water availability and its advantages and disadvantages to the organisms that excrete it.

☐ **Question 38** **(10 marks)**

A biologist used DNA data to investigate the relationship between red and gray wolves. Describe how the technique of gel electrophoresis could be used to compare the DNA of these two species.

See next page

See next page

See next page

See next page

Part A

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

☐ **Question 36** **(10 marks)**

Describe the process of biological control and discuss the advantages and disadvantages of biological control as a method of pest control.

☐ **Question 37** **(10 marks)**

Vertebrates excrete three forms of nitrogenous waste. Select **two** of these and, in each case, name the form of nitrogenous waste and discuss its characteristics in relation to water availability and its advantages and disadvantages to the organisms that excrete it.

☐ **Question 38** **(10 marks)**

A biologist used DNA data to investigate the relationship between red and gray wolves. Describe how the technique of gel electrophoresis could be used to compare the DNA of these two species.

See next page

See next page

See next page

See next page

Part B

Answer any **two (2)** questions from Questions 39 to 41. **(20 marks)**

Indicate the first question from Part B you will answer by ticking the box next to the question. Write your answer on pages 38–40. When you have answered your first question, turn to page 41 and indicate the second question you will answer on that page.

☐ **Question 39** **(10 marks)**

Explain the processes involved in water moving from the soil into a root cell of a crop plant, like wheat or lucerne, and explain why a crop plant will not survive if planted in soil that has a very high level of salt.

☐ **Question 40** **(10 marks)**

Explain how biomagnification arises and why it is detrimental to the environment.

☐ **Question 41** **(10 marks)**

The Galapagos Islands are made up of many islands. Different islands have their own unique species of Darwin's finch (a type of bird). The different species have their own songs, food preferences and beak shapes. The different species evolved from one ancestral species that colonised each of the islands and then specialised.

Use your knowledge of the evolutionary process, to explain how one ancestral species has given rise to the different species of Darwin's finch on each island.

See next page

See next page

See next page

See next page

Part B

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

☐ **Question 39** **(10 marks)**

Explain the processes involved in water moving from the soil into a root cell of a crop plant, like wheat or lucerne, and explain why a crop plant will not survive if planted in soil that has a very high level of salt.

☐ **Question 40** **(10 marks)**

Explain how biomagnification arises and why it is detrimental to the environment.

☐ **Question 41** **(10 marks)**

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Use your knowledge of the evolutionary process, to explain how one ancestral species has given rise to the different species of Darwin's finch on each island.

End of questions

Additional working space

Question number: _____

Additional working space

Question number: _____

Additional working space

Question number: _____

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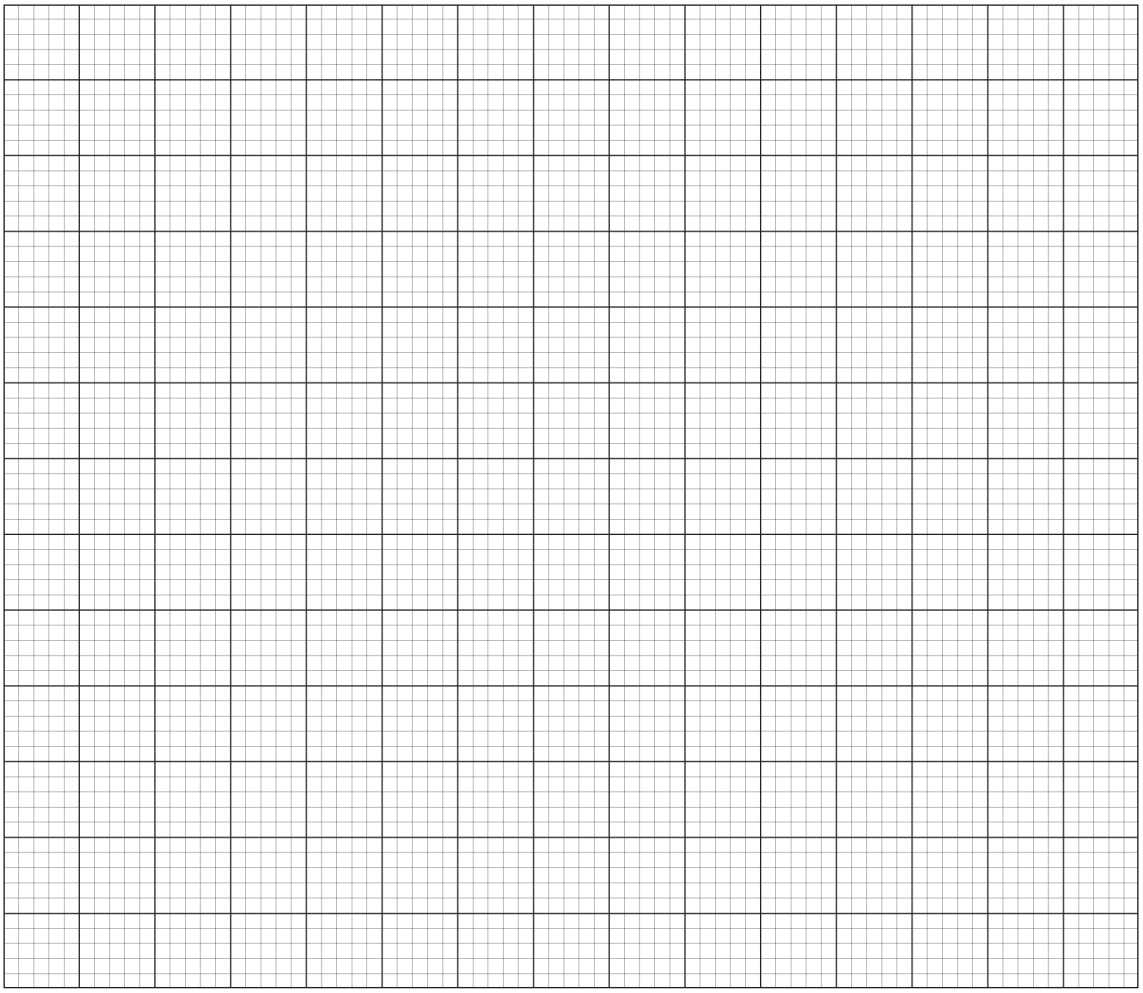
Additional working space

Question number: _____



ACKNOWLEDGEMENTS

Section One

Question 1 Diagram adapted from: Pierce, B. A. (2008). *Genetics: A conceptual approach*. New York: W.H. Freeman, p. 340.

Questions 7–8 Data source: Offord, C.A., Cuneo, P.V., & Mckensy, M.L. (2004). Critical review of threatened species collections in the New South Wales Seedbank: Implications for ex situ conservation of biodiversity. *Pacific Conservation Biology* 10(4), pp. 221–236.

Questions 13–14 Adapted from: Tomiak, P., & Marx, F.G. (n.d.). *Phylogenetic tree* [Image]. Retrieved March, 2014, from http://palaeo.gly.bris.ac.uk/palaeofiles/whales/mysticeti.htm

Adapted from: Chris huh. (2006). *Series of whale drawings on a phylogenetic tree of the mysticetes* [Images]. Retrieved March, 2014, from http://palaeo.gly.bris.ac.uk/palaeofiles/whales/mysticeti.htm

Question 16 Adapted from: Weinert, B., & Weinert, L. (2006). *Sonoran collared lizard* [Image]. Retrieved April, 2014, from www.herpindiego.com/AjoMountainTripReport.html

Section Two

Question 31 Data source: Petit, J.R., Jouzel, J., Raynaud, D., Barkov, N.I., Barnola, J.M., Basile, I., Bender, M., Chappellaz, J., Davis, M., Delaygue, G., Delmotte, M., Kotlyakov, V.M., Legrand, M., Lipenkov, V.Y., Lorius, C., PÉpin, L., Ritz, C., Saltzman, E., & Stievenard, M. (1999, June 3). Climate and atmospheric history of the past 420,000 years from the Vostok ice core, Antarctica. *Nature*, 399, pp. 429–436.

Question 35 Adapted from: Brindley, A., Pickersgill, R.W., Partridge, J.C., Dunstan, D.J., Hunt, D.M., & Warren, M.J. (2008, April 30). Enzyme sequence and its relationship to hyperbaric stability of artificial and natural fish lactate dehydrogenases, Figure 3 [Graph]. *PLoS ONE*, 3(4): e2042. Doi:10.1371/journal.pone.0002042.

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CANNINGTON WA 6107