**Western Australian Certificate of Education
Examination, 2015**

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.

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 2015*. 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.

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.   The products of anaerobic respiration in animals are energy and

       (a)   ethanol.
       (b)   lactic acid.
       (c)   carbon dioxide and ethanol.
       (d)   carbon dioxide and lactic acid.

2.   Anaerobic respiration in a plant cell occurs in the

       (a)   cytoplasm.
       (b)   nucleus.
       (c)   chloroplasts.
       (d)   mitochondria.

3.   Meiosis usually involves

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

4.   Greenhouse gases cause global warming by

       (a)   absorbing infrared (longwave length) radiation from the earth's surface.
       (b)   absorbing ultraviolet (shortwave length) radiation from the earth's surface.
       (c)   increasing the amount of incoming solar radiation that reaches the earth's surface.
       (d)   decreasing the amount of incoming solar radiation that reaches the earth's surface.

5.   Which of the following is a significant greenhouse gas?

       (a)   nitrogen
       (b)   carbon monoxide
       (c)   oxygen
       (d)   methane

6.   The mean concentration of mercury (a heavy metal) in krill is 0.077 μg/g. If a Chinstrap Penguin consumes a mean of 100 g of krill per day, how many grams of mercury will the penguin consume in 30 days?

(a)   0.231
(b)   7.7
(c)   231
(d)   3000

7.   The process whereby a heavy metal becomes more concentrated in the tissues of organisms at each higher trophic level is called

(a)   biochemistry.
(b)   bioconcentration.
(c)   biomagnification.
(d)   biotechnology.

8.   Most of the bacteria in a population are killed by an antibiotic, but a few cells survive to reproduce and produce the next generation. Compared to those in the previous generation, the bacteria in the next generation are likely to be

(a)   more susceptible to mutation.
(b)   less susceptible to mutation.
(c)   more susceptible to the antibiotic.
(d)   less susceptible to the antibiotic.

9.   Endocytosis is a type of

(a)   active transport of material out of a cell.
(b)   active transport of material into a cell.
(c)   passive transport of material out of a cell.
(d)   passive transport of material into a cell.

10.   In gene cloning, the main purpose of plasmids is to

(a)   identify the gene for cloning.
(b)   extract the desired gene from a donor organism.
(c)   produce many copies of the desired gene.
(d)   introduce the desired gene into a recipient organism.

11.   Which of the following environmental impacts is needed for the long-term maintenance of biodiversity in temperate forest ecosystems in Australia?

(a)   dryland salinity
(b)   fire
(c)   logging
(d)   climate change

See next page

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Question 12 relates to the following phylogenetic tree, which shows the relationships between representatives of the main groups of vertebrates and the points at which certain characteristics arose in the evolution of these groups.
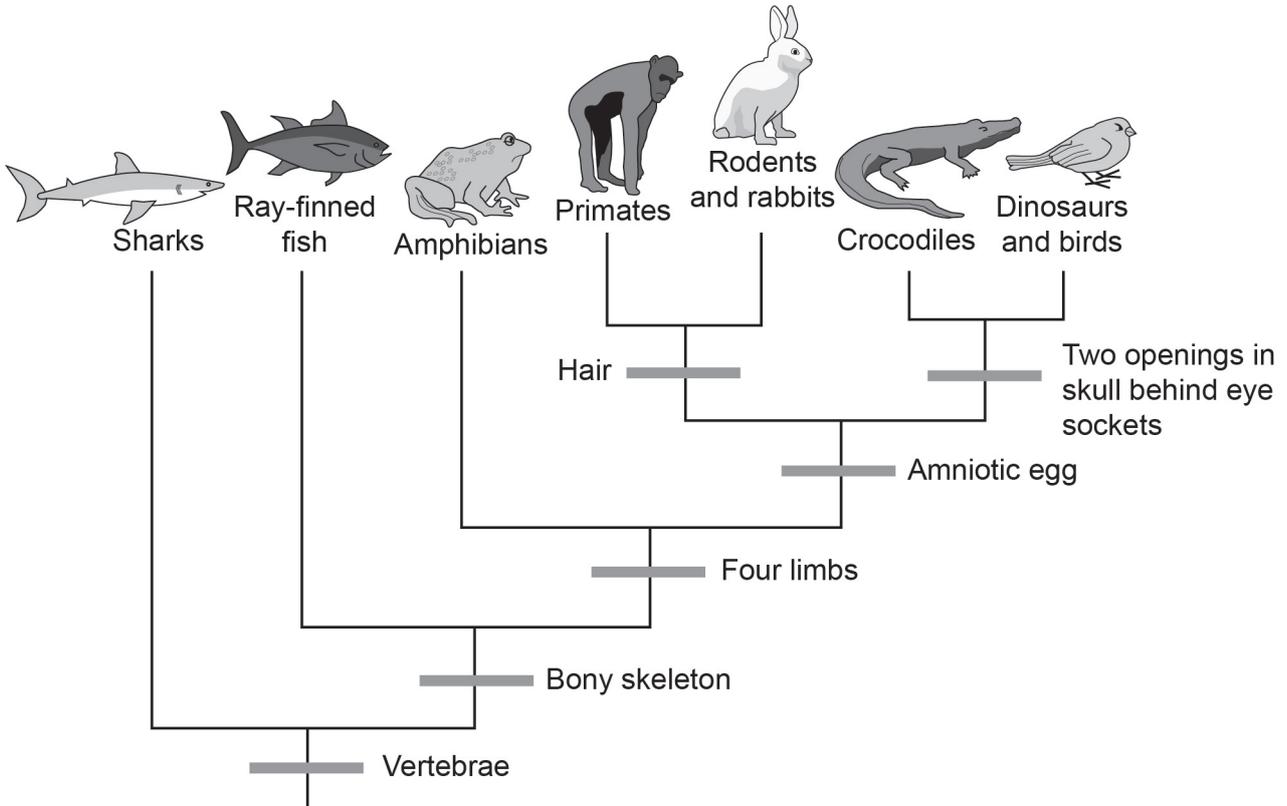
12.   Which of the following characteristics do primates and rabbits share with crocodiles and birds, but not with other vertebrates in the tree?

(a)   hair
(b)   vertebrae
(c)   four limbs
(d)   amniotic egg

13.   The reliability of a scientific experiment can be improved by

(a)   repeating the experiment.
(b)   removing outliers.
(c)   including a control.
(d)   changing the experimental method.

14.   The Arctic Fox has a thick fur coat. The fur traps a layer of air close to the body of the fox and reduces heat loss by

(a)   evaporation.
(b)   conduction.
(c)   radiation.
(d)   convection.

See next page

Questions 15 to 17 relate to the following information.

Biologists designed an experiment to investigate which of four landscape treatments would attract the largest numbers of the Common Blue Butterfly to a location. The experiment ran at four different locations. At each location, four different landscape treatments were set up as follows:

> Control (C) = the landscape was left undisturbed.
> Mound (M) = the landscape had a limestone mound to encourage the growth of specific plants.
> Short (S) = the landscape was sown with short-growing grasses and wildflowers.
> Tall (T) = the landscape was sown with tall-growing grasses and wildflowers.

The biologists then monitored the numbers of butterflies on each treatment at each location for three years. The results are shown in the graph below. The treatments are shown on the horizontal axis and the result for each of the four locations is shown with different patterns in the bars.
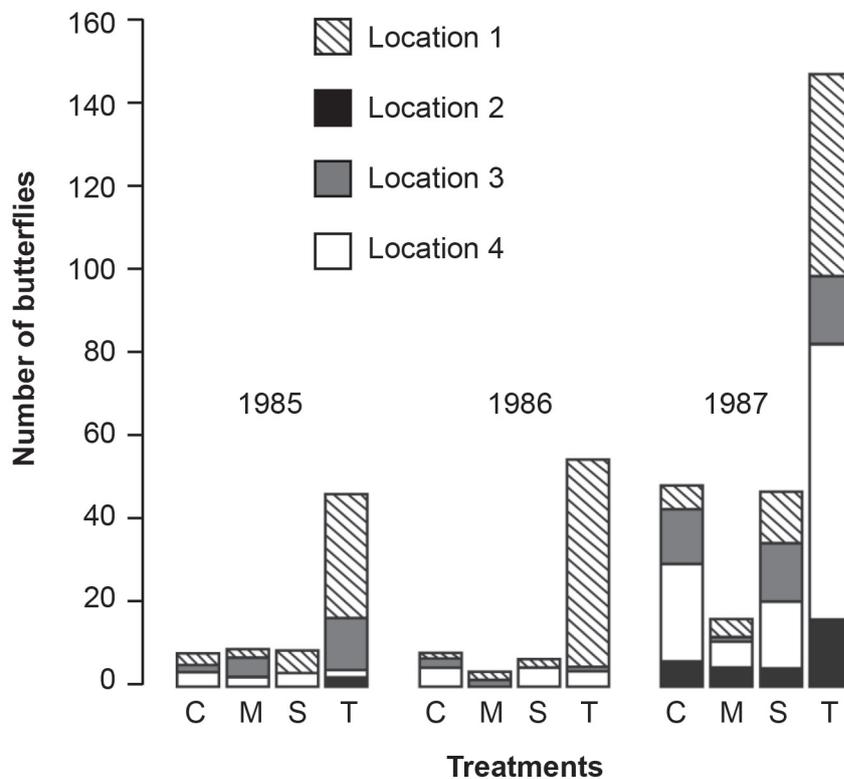
15.   The dependent variable in this experiment is the

(a)   number of butterflies.
(b)   landscape treatment.
(c)   location at which the experiment took place.
(d)   year in which the measurement was taken.

See next page

16. Which of the following is a suitable hypothesis for the experiment?

    (a) Does landscape treatment influence the number of butterflies at a location?
    (b) Landscape treatment does not influence the number of butterflies at a location.
    (c) Is the number of butterflies the same at different locations?
    (d) The number of butterflies is the same at different locations.

17. Which location had the greatest number of butterflies in 1987?

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

18. Which of the following statements about nitrogenous waste is correct?

    (a) Ammonia is more toxic than uric acid.
    (b) Uric acid is more soluble in water than urea.
    (c) It takes more energy to produce urea than uric acid.
    (d) It takes more water to excrete urea than ammonia.

19. Marine mammals are usually large in size. This is an advantage because it means that the individuals have a

    (a) large surface area to volume ratio, which reduces heat loss to the environment.
    (b) large surface area to volume ratio, which increases heat loss to the environment.
    (c) small surface area to volume ratio, which reduces heat loss to the environment.
    (d) small surface area to volume ratio, which increases heat loss to the environment.

20. Which of the following equations about ATP and ADP cycles is correct?

    (a) ADP = ATP + P - energy
    (b) ATP = ADP + P - energy
    (c) ADP = ATP + P + energy
    (d) ATP = ADP + P + energy

21. Which row in the following table correctly matches an enzyme with its function?

	Enzyme	Function
(a)	DNA polymerase	cuts a DNA molecule at a specific sequence
(b)	RNA polymerase	degrades RNA molecules
(c)	ligase	joins two DNA molecules together
(d)	restriction enzyme	synthesises a new strand of DNA

Questions 22 to 24 relate to the diagram below, which shows a cell process.

For copyright reasons this image cannot be reproduced in the online version of this document, but may be viewed at http://biology.about.com/
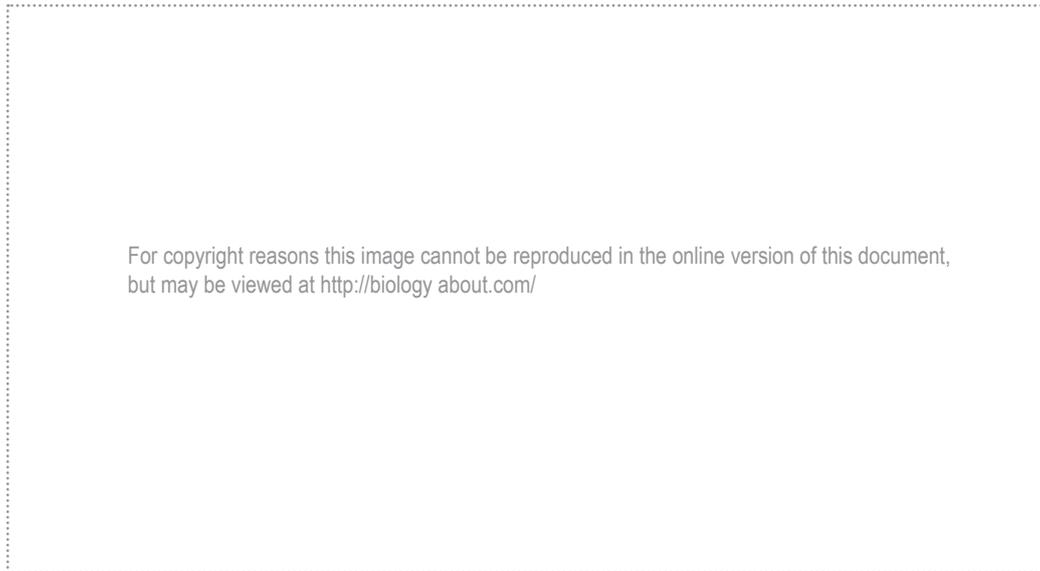
22. The process shown in the diagram is

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

23. The feature labelled X is a molecule of

    (a) protein.
    (b) DNA.
    (c) tRNA.
    (d) mRNA.

24. The function of the feature labelled Y is to

    (a) carry the genetic code from the DNA to the site of protein synthesis.
    (b) encode the sequence of amino acids in a protein chain.
    (c) transfer amino acids to the growing peptide chain during protein synthesis.
    (d) correct errors in the sequence of amino acids in a protein chain.

25. Which of the following properties will be greater in an urban ecosystem compared to a modern agricultural ecosystem?

    (a) energy flow
    (b) heat output
    (c) productivity
    (d) recycling

See next page

Questions 26 and 27 relate to the following information.

A biologist studied a population of the endangered Eastern Barred Bandicoot. He estimated the percentage contributions of several causes of mortality in the bandicoots. The results are summarised in the table below.

Cause of mortality	% Mortality					
	Juveniles		Subadults		Adults	
	Male	Female	Male	Female	Male	Female
Road death	23.1	12.5	80	55.6	73.8	60.0
Predation by cats	38.5	45.8	0	33.3	0	0
Agricultural machinery	7.6	4.2	0	0	1.6	3.3
Disease	3.9	8.3	0	0	8.2	10.0
Trap death	3.9	8.3	0	0	4.9	3.3
Predation by dogs	0	0	0	0	3.3	3.3
Unknown cause	23.1	20.8	20	11.1	8.2	20.0
Total number of animals studied	**26**	**24**	**10**	**9**	**61**	**30**

26.   The number of juvenile bandicoots (males and females) killed by cats was

      (a)   21.
      (b)   39.
      (c)   50.
      (d)   84.

27.   The data suggest that

      (a)   the main cause of mortality in subadult bandicoots is unknown.
      (b)   subadult bandicoots do not get diseases.
      (c)   male bandicoots have more road deaths than female bandicoots.
      (d)   juvenile bandicoots have more predation by dogs than adult bandicoots.

Question 28 relates to the following diagram, which shows a phospholipid molecule from a cell membrane.

 ← Hydrophilic (polar) head

28. Which of the following shows the orientation of phospholipid molecules in the cell membrane?

(a)   outside of cell

       inside of cell

(b)   outside of cell

       inside of cell

(c)   outside of cell

       inside of cell

(d)   outside of cell

       inside of cell
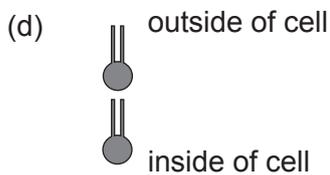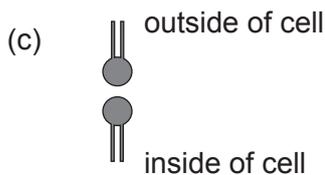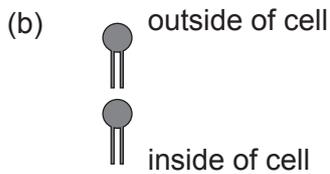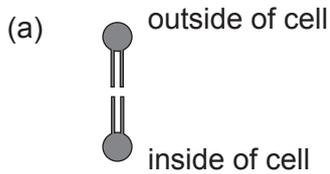
29. Conservation strategies are often divided into in situ (where conservation occurs in the natural habitat) and ex situ (where the conservation takes place outside of the natural habitat). Which of the following is an in situ conservation strategy?

(a)   seed banks
(b)   national parks
(c)   captive breeding programs
(d)   botanical gardens

30. Birds are

(a)   ectothermic and excrete nitrogenous waste as urea.
(b)   ectothermic and excrete nitrogenous waste as uric acid.
(c)   endothermic and excrete nitrogenous waste as urea.
(d)   endothermic and excrete nitrogenous waste as uric acid.

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 graphs and diagrams may be drawn in pencil.

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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: 90 minutes.

Question 31   **(20 marks)**

(a)   Outline **three** reasons why it is important to conserve biodiversity.   (6 marks)

One: _____

_____

Two: _____

_____

Three: _____

_____

(b)   State **three** genetic strategies that can be used to maintain biodiversity.   (3 marks)

One: _____

Two: _____

Three: _____

Question 31 (continued)

(c) The Asian Tiger Mosquito is a significant pest because it lives in close association with humans and transmits several viral diseases. This mosquito is native to southeast Asia, but is predicted to invade Australia. It has been suggested that a biological control agent could be used to contain the spread of the Asian Tiger Mosquito in Australia if it should reach this country.

(i) Where should biologists search for a potential biological control agent for the Asian Tiger Mosquito? Give a reason for your answer. (2 marks)

_____

_____

_____

_____

(ii) List **three** checks that should be made before any proposed biological control agent for the Asian Tiger Mosquito is released in Australia. (3 marks)

One: _____

Two: _____

Three: _____

(d) An Ecosphere is a sealed glass container that contains a self-sustaining miniature ecosystem. A biologist used an Ecosphere containing air, water, microorganisms, algae (photosynthetic autotrophs) and shrimps (small crustaceans) to simulate human impacts on ecosystems.

(i) Is the Ecosphere most like a natural, agricultural or urban ecosystem? Give a reason for your answer. (2 marks)

_____

_____

_____

_____

The biologist added fertiliser rich in phosphorus to the Ecosphere.

(ii)   Name the environmental impact the biologist was trying to simulate by adding the phosphorus to the Ecosphere.   (1 mark)

_____

_____

(iii)   Within three weeks of the addition of the phosphorus fertiliser, all of the shrimps in the Ecosphere died. Explain why.   (3 marks)

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Question 32 **(20 marks)**

Florists often sell cut flowers of chrysanthemums. A cut flower consists of a stem cutting with some leaves and flowers. A biologist conducted an experiment to investigate the effects of light intensity on leaf condition and vase life in cut flowers of chrysanthemums. The results are shown in the following table.

Light intensity (Foot candles)	Photosynthetic rate (μL O_2 evolved per hour per cm^2 of leaf)	Respiration rate (μL O_2 consumed per hour per cm^2 of leaf)	Vase life (days)
400	46	11	11+
200	31	9	11+
100	14	8	11
50	10	8	11
25	3	6	9
13	2	4	8
7	No data	No data	8
0	No data	No data	7

(a) Graph the relationship between light intensity and the rate of photosynthesis in the cut flowers of chrysanthemums in a line graph. (5 marks)

A spare grid is provided at the end of this Question/Answer Booklet. If you need to use it, cross out this attempt.
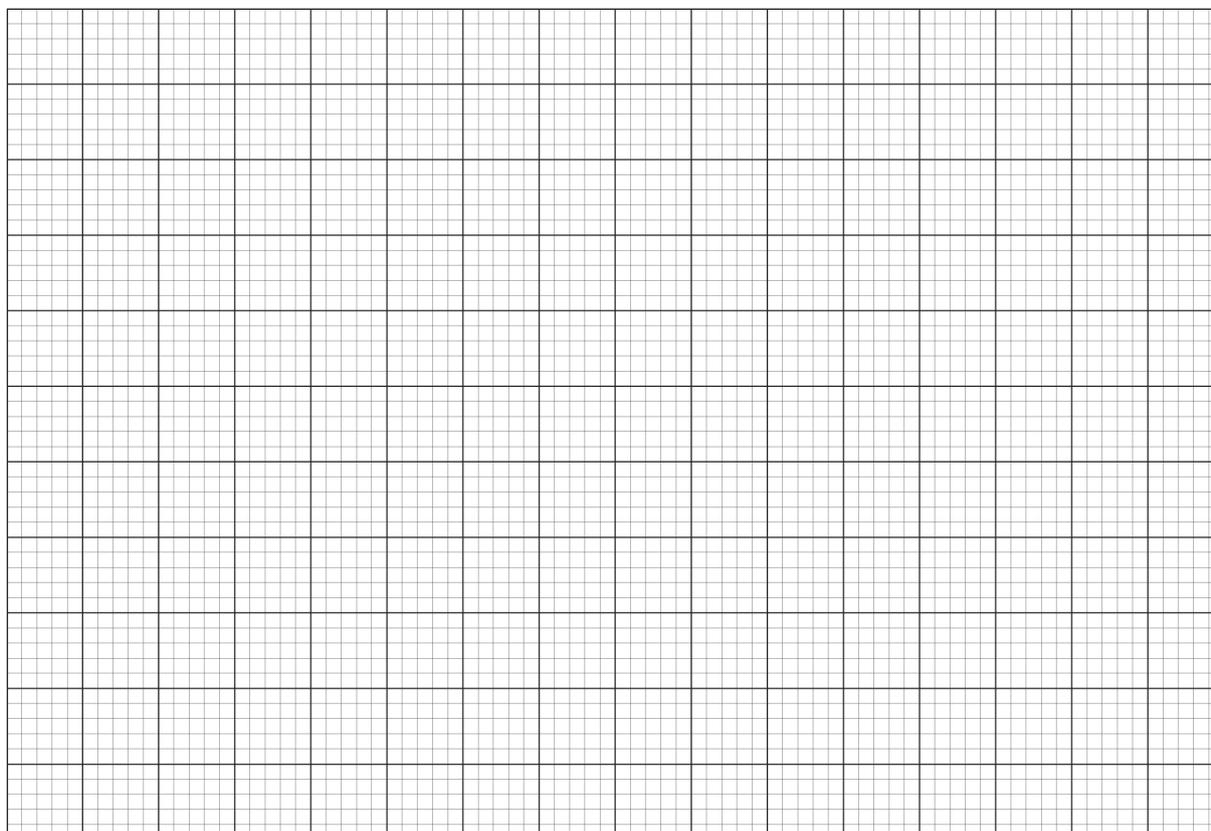
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(b) In the experiment described, the rate of photosynthesis in the cut flowers of chrysanthemums increased with light intensity. Explain why increased light intensity increases the rate of photosynthesis in chrysanthemums and other plants.   (4 marks)

_____

_____

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(c) In the experiment described, the rate of respiration in the cut flowers of chrysanthemums also increased with light intensity. Suggest a plausible reason for this.   (3 marks)

_____

_____

_____

_____

_____

_____

(d) Transpiration is a process that occurs in plants.

   (i) Define the term 'transpiration'.   (1 mark)

_____

_____

   (ii) List **three** distinctly different aspects of leaf structure that can influence the rate of transpiration.   (3 marks)

One: _____

Two: _____

Three: _____

See next page

Question 32 (continued)

(e)   Explain how a plant can use transpiration to help regulate its temperature.   (4 marks)

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Question 33 **(19 marks)**

(a) A biologist wanted to study the abundance of fish in a seagrass bed and an adjacent sand flat in Shark Bay. To do this, the biologist needed to sample fish. List **four** ethical practices that the biologist should employ when sampling the fish. (4 marks)

One: _____

_____

Two: _____

_____

Three: _____

_____

Four: _____

_____

(b) The following table shows the mean number of fish that the biologist caught from a seagrass bed and an adjacent sand flat during the day and night at two different times of the year.

	Seagrass bed		Sand flat	
	Day	Night	Day	Night
February	274.7	242.3	189.0	209.3
June	152.0	228.0	81.0	75.3

Identify **four** patterns in fish abundance that are evident in the data. (4 marks)

One: _____

_____

Two: _____

_____

Three: _____

_____

Four: _____

_____

See next page

Question 33 (continued)

(c)   The biologist used the same sampling methods to catch the fish from the seagrass bed and sand flat in the study discussed in parts (a) and (b). Explain why this was important.

(3 marks)

_____

_____

_____

_____

_____

_____

(d)   *Arenophryne rotunda* is a species of frog that lives in sand dunes around Shark Bay. The frogs typically stay in a burrow during the day, but move around on the sand dunes during the night. Outline a trapping technique that would be suitable for catching these frogs.

(4 marks)

_____

_____

_____

_____

_____

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_____

(e)   Explain why a marine bony fish needs to ingest seawater to maintain its water balance.

(4 marks)

_____

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See next page

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Question 34 **(21 marks)**

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

(i) The base sequence of a newly-synthesised strand of DNA is identical to that of the template strand from which it was synthesised. (2 marks)

True False

Reason: _____

(ii) DNA replication is called 'semi-conservative' because the wrong base is sometimes added to the newly-synthesised strand of DNA. (2 marks)

True False

Reason: _____

(b) Polymerase Chain Reaction (PCR) is an important method in biotechnology.

(i) What is PCR used to do? (2 marks)

_____

_____

_____

_____

(ii) State **three** reagents (ingredients) that are required for PCR. (3 marks)

One: _____

Two: _____

Three: _____

(c) (i) Distinguish between a gene and an allele. (2 marks)

_____

_____

_____

_____

See next page

Question 34 (continued)

(ii)   Distinguish between a dominant allele and a recessive allele.   (2 marks)

_____

_____

_____

_____

(d)   (i)   Define the term 'gene pool'.   (1 mark)

_____

_____

(ii)   State **one** major similarity between the processes of natural selection and genetic drift.   (1 mark)

_____

_____

(iii)   State **one** major difference between the processes of natural selection and genetic drift.   (2 marks)

_____

_____

_____

_____

(e)   (i)   Define the term 'gene flow'.   (1 mark)

_____

_____

(ii)   Explain the importance of barriers to gene flow in the process of speciation.

(3 marks)

_____

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_____

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Question 35 **(20 marks)**

(a) Biodiversity is generally studied at three levels. State these **three** levels. (3 marks)

One: _____

Two: _____

Three: _____

(b) The following table shows the results of a study on introduced plant species in Kosciuszko National Park. The study recorded the number of introduced species for each of four plant types in three habitats in disturbed and undisturbed areas of the park.

Number of plant species in different categories						
Plant type	**Undisturbed**			**Disturbed**			***Total number of different species found**
	Alpine	Subalpine	Montane	Alpine	Subalpine	Montane	
herb	4	10	29	6	31	39	51
grass	2	9	13	4	23	19	29
shrub			1		5	1	6
tree		2	2		5	1	6

* Some species were found in multiple habitats and areas.

(i) Which habitat in which area had the highest number of introduced plant species and how many species were present? (2 marks)

_____

_____

(ii) What was the total number of introduced plant species (for all plant types combined) recorded in the study? (1 mark)

_____

(iii) Calculate the percentage contributions of herb and shrub plant types to the total number of introduced plant species. (2 marks)

Plant type	Per cent (%)
herb	
grass	32
shrub	
tree	6.5

See next page

(c)   In the space below, graph the data on the percentage contribution of each plant type to the total number of introduced species for the data set in part (b). Do **not** use a line graph. (4 marks)

Question 35 (continued)

The herb *Acetosella vulgaris* is one of the introduced plant species that was observed in Kosciuszko National Park. This species is native to Europe, North America and Asia but was introduced to Australia.

(d)   Outline a genetic strategy that could be used to determine whether the populations of this species in Kosciuszko National Park were introduced from Europe, North America or Asia. (4 marks)

Data suggest that the number of introduced plant species in Kosciuszko National Park has increased during the past 30 years. Some people have suggested that this is due to climate change/global warming.

(e)   Explain how climate change could cause an increase in the number of introduced plant species in Kosciuszko National Park. (4 marks)

End of Section Two

See next page

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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 30.
Part B questions commence on page 34 and are repeated on page 38.

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.

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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 answers on the pages provided. When you have answered your first question, turn to page 30 and indicate the second question you will answer on that page.

| | **Question 36** | **(10 marks)** |

Dryland salinity is a major ecological problem in Western Australia. Explain how dryland salinity arises and list **four** distinctly different measures that can be used to remedy it.

| | **Question 37** | **(10 marks)** |

Describe the general principles of negative feedback in homeostasis and explain why a mammal needs to maintain the amount of carbon dioxide in its blood within certain limits.

| | **Question 38** | **(10 marks)** |

Artificial selection and transgenesis (the production of transgenic organisms) are two methods that humans use to change the features of plants or animals. Describe how artificial selection and transgenesis can each be used to change the features of plants or animals.

Question number: _____

Question number: _____

Question number: _____

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)**

Dryland salinity is a major ecological problem in Western Australia. Explain how dryland salinity arises and list **four** distinctly different measures that can be used to remedy it.

☐ **Question 37** **(10 marks)**

Describe the general principles of negative feedback in homeostasis and explain why a mammal needs to maintain the amount of carbon dioxide in its blood within certain limits.

☐ **Question 38** **(10 marks)**

Artificial selection and transgenesis (the production of transgenic organisms) are two methods that humans use to change the features of plants or animals. Describe how artificial selection and transgenesis can each be used to change the features of plants or animals.

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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 the pages provided. When you have answered your first question, turn to page 38 and indicate the second question you will answer on that page.

☐ **Question 39** **(10 marks)**

The Noisy Scrub-bird is a small, insect-eating bird. It can only fly short distances, but is very agile in flight and on the ground, where it can run quickly. It prefers low, dense, long-unburnt vegetation on the boundaries between swamp and forest. It feeds on or near the ground. It builds nests within 20 cm of the ground in low vegetation. There is usually only one chick per clutch. The Noisy Scrub-bird is found only in a small area on the south coast of Western Australia, although it was more widely distributed in the past.

Considering the Noisy Scrub-bird's biology, describe **two** distinctly different strategies that could be used to conserve the Noisy Scrub-bird and, in each case, explain why the strategy would be effective.

☐ **Question 40** **(10 marks)**

Explain how enzymes work and why they are important in biological processes.

☐ **Question 41** **(10 marks)**

Explain how fossils and the embryology of vertebrates can each provide evidence for evolution.

See next page

Question number: _____

See next page

Question number: _____

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Question number: _____

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.

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☐ **Question 39** **(10 marks)**

The Noisy Scrub-bird is a small, insect-eating bird. It can only fly short distances, but is very agile in flight and on the ground, where it can run quickly. It prefers low, dense, long-unburnt vegetation on the boundaries between swamp and forest. It feeds on or near the ground. It builds nests within 20 cm of the ground in low vegetation. There is usually only one chick per clutch. The Noisy Scrub-bird is found only in a small area on the south coast of Western Australia, although it was more widely distributed in the past.

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☐ **Question 40** **(10 marks)**

Explain how enzymes work and why they are important in biological processes.

☐ **Question 41** **(10 marks)**

Explain how fossils and the embryology of vertebrates can each provide evidence for evolution.

End of questions

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ACKNOWLEDGEMENTS