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

ATAR course examination, 2017

Question/Answer booklet

BIOLOGY

Place one of your candidate identification labels in this box.

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

Student number: In figures

In words _____

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

Number of additional
answer booklets used
(if applicable):

Materials required/recommended for this paper
To be provided by the supervisor
This Question/Answer booklet
Multiple-choice answer sheet

To be provided by the candidate
Standard items: pens (blue/black preferred), pencils (including coloured), sharpener,
        correction fluid/tape, eraser, ruler, highlighters

Special items: non-programmable calculators approved for use in this examination

Important note to candidates
No other items may be taken into the examination room. It is **your** responsibility to ensure that
you do not have any unauthorised material. If you have any unauthorised material with you, hand
it to the supervisor **before** reading any further.

Ref: 17-009

BLY

Structure of this paper

Section	Number of questions available	Number of questions to be answered	Suggested working time (minutes)	Marks available	Percentage of examination
Section One Multiple-choice	30	30	40	30	30
Section Two Short answer	5	5	90	100	50
Section Three Extended answer Unit 3	2	1	50	40	20
Unit 4	2	1			
				Total	100

Instructions to candidates

1. The rules for the conduct of the Western Australian external examinations are detailed in the *Year 12 Information Handbook 2017*. 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.

   Section Two: Write your answers in this Question/Answer booklet. Wherever possible, confine your answers to the line spaces provided.

   Section Three: Consists of two parts each with two questions. You must answer one question from each part. Tick the box next to the question you are answering. Write your answers in this Question/Answer booklet.

3. You must be careful to confine your answers to the specific questions asked and to follow any instructions that are specific to a particular question.

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

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. DNA replication is described as

   (a) conservative, because each new double helix consists of one parental and one newly-synthesised DNA strand.
   (b) conservative, because each new double helix consists of two newly-synthesised DNA strands.
   (c) semi-conservative, because each new double helix consists of one parental and one newly-synthesised strand.
   (d) semi-conservative, because each new double helix consists of two newly-synthesised DNA strands.

2. Which of the following is ectothermic and excretes uric acid?

   (a) bird
   (b) lizard
   (c) fish
   (d) mammal

3. The woolly mammoth was a large mammal that became extinct approximately 4000 years ago. Reduced genetic diversity associated with a small population size contributed to the extinction of this species and was probably due to

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

4. Bacterial cells reproduce by

   (a) binary fission only.
   (b) meiosis only.
   (c) binary fission and mitosis.
   (d) mitosis and meiosis.

5. Which of the following human diseases is transmitted by a vector?

   (a) influenza
   (b) tuberculosis
   (c) tetanus
   (d) malaria

See next page

Question 6 relates to the information below.

The following phylogenetic tree shows the evolutionary relationships among eight plant species.
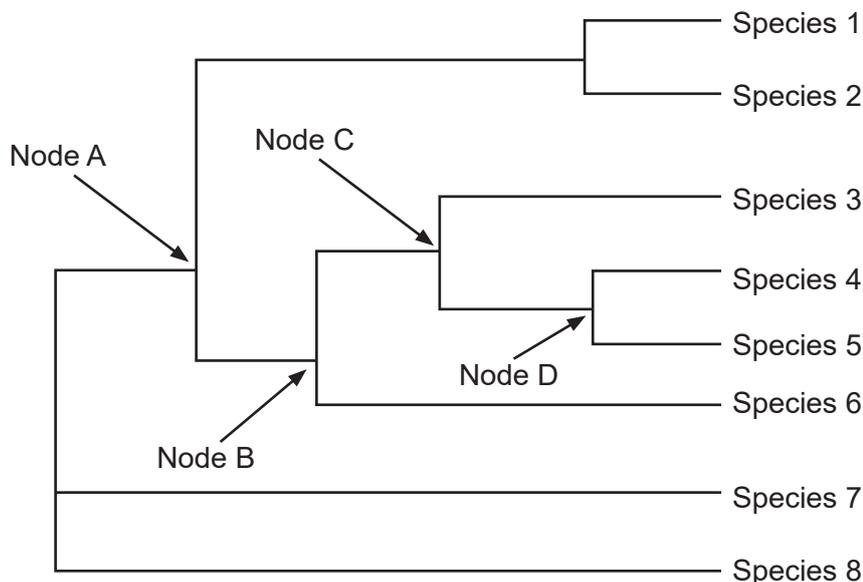
6. Which node (branch point) in the phylogenetic tree represents the **most** recent common ancestor of species 3, 4, 5 and 6?

(a) Node A
(b) Node B
(c) Node C
(d) Node D

7. The number of tRNA molecules needed to synthesise the first 24 amino acids of a polypeptide chain is

(a) 8.
(b) 24.
(c) 25.
(d) 72.

8. The approximate number of amino acids that could be coded for by a (mature) mRNA molecule comprising 1500 nucleotides is

(a) 150.
(b) 300.
(c) 500.
(d) 750.

See next page

9. In the genetic code, other than for stop codons,

   (a) each codon codes for only one amino acid but most amino acids are coded for by more than one codon.
   (b) each codon codes for only one amino acid and each amino acid is coded for by only one codon.
   (c) most codons code for more than one amino acid but each amino acid is coded for by only one codon.
   (d) most codons code for more than one amino acid and most amino acids are coded for by more than one codon.

10. *Phytophthora* dieback is caused by a

    (a) virus.
    (b) bacterium.
    (c) fungus.
    (d) protist.

11. In watermelons, fruit bitterness is determined by two alleles at a gene, where an allele for bitter fruit is dominant over an allele for sweet fruit. A plant that is heterozygous for these two alleles is crossed with a plant with sweet fruit. The expected fruit phenotypes in the progeny of these plants is

    (a) all bitter fruit.
    (b) all sweet fruit.
    (c) 50% bitter fruit and 50% sweet fruit.
    (d) 75% bitter fruit and 25% sweet fruit.

12. Adaptations by plants to high soil salinity include the

    (a) active uptake of salt into root cells so that water moves by osmosis from the soil into the root cells.
    (b) active uptake of salt into root cells so that water moves by osmosis from the root cells into the soil.
    (c) exclusion of salt from root cells so that water moves by osmosis from the soil into the root cells.
    (d) exclusion of salt from root cells so that water moves by osmosis from the root cells into the soil.

13. In DNA replication, the enzyme DNA polymerase

    (a) unwinds the DNA double helix.
    (b) seals short stretches of nucleotides.
    (c) adds nucleotides to a DNA strand.
    (d) adds RNA primers to a DNA strand.

See next page

14. A cell in the root tip of a bean plant has a total of 12 chromosomes. A mitotic division of this cell will produce

   (a) two daughter cells, each with 12 chromosomes.
   (b) two daughter cells, each with 6 chromosomes.
   (c) four daughter cells, each with 12 chromosomes.
   (d) four daughter cells, each with 6 chromosomes.

Questions 15 to 17 refer to the information below.

Biologists counted the number of seeds produced by the flowers on five plants infected with a disease. The data are shown in the table. Note that some plants had more flowers than others.

**The number of seeds per flower for each of the five plants**

	Flower 1	**Flower 2**	**Flower 3**	**Flower 4**
Plant 1	17	22	18	18
Plant 2	12	2	9	–
Plant 3	40	16	13	14
Plant 4	21	18	–	–
Plant 5	41	–	–	–

15. The range in the number of flowers per plant is

   (a) 0–41.
   (b) 2–41.
   (c) 0–4.
   (d) 1–4.

16. The mean number of seeds per flower for Plant 2 is

   (a) 5.8.
   (b) 7.7.
   (c) 14.5.
   (d) 18.8.

17. The pathogen that infected the plants has cells with a true nucleus, mitochondria and a cell wall made of chitin and is therefore a

   (a) bacterium.
   (b) fungus.
   (c) protist.
   (d) virus.

See next page

18. The diploid number of chromosomes in the chimpanzee is 48. A chimpanzee with stunted growth and other abnormalities was found to have 49 chromosomes. The **most** likely source of the extra chromosome in this chimpanzee is

    (a) a viral infection in the chimpanzee.
    (b) a viral infection in one of the parents of the chimpanzee.
    (c) an error in meiosis in the chimpanzee.
    (d) an error in meiosis in one of the parents of the chimpanzee.

Questions 19 and 20 relate to the diagram below.

A biologist measured the growth rate and the thickness of back fat in a group of pigs. The results are shown in the diagram, where each 'X' represents one pig. The biologist divided the pigs into four groups (A, B, C and D) according to their growth rate and thickness of back fat, as shown in the diagram.
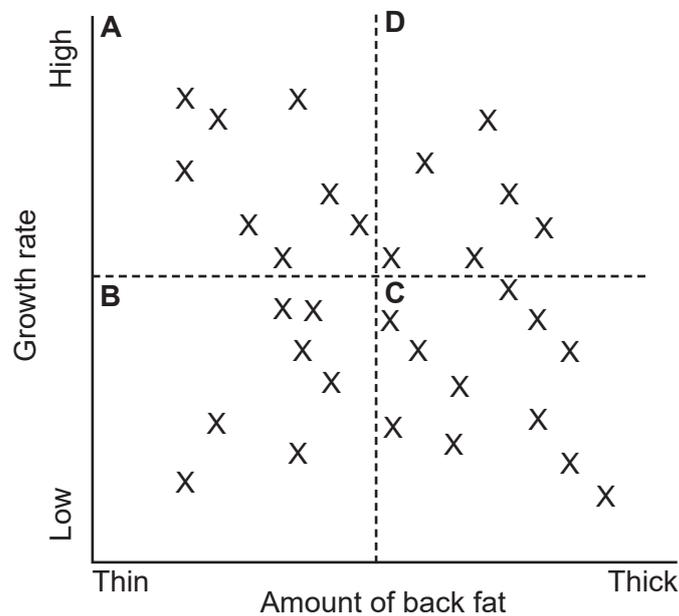
19. What type of trait is growth rate in this group of pigs?

    (a) autosomal
    (b) recessive
    (c) dominant
    (d) polygenic

20. The biologist wants to use selective breeding to produce pigs with a high growth rate and thin back fat. The **best** animals to select for breeding for this purpose are those in group

    (a) A.
    (b) B.
    (c) C.
    (d) D.

See next page

21. Which of the following describes the problems that a bony fish encounters in a freshwater environment?

    (a)   gain of water and salt from the environment
    (b)   loss of water and salt to the environment
    (c)   gain of water from the environment and loss of salt to the environment
    (d)   loss of water to the environment and gain of salt from the environment

22. In an experiment, the factor that is manipulated by the experimenter is called

    (a)   a control.
    (b)   a dependent variable.
    (c)   an independent variable.
    (d)   a replicate.

Question 23 relates to the information below.

The following is a list of the main steps in the life cycle of a virus in no particular order.

    Step A   Viral proteins and nucleic acids are assembled in the host cell.
    Step B   The virus binds to the host cell.
    Step C   The virus injects its nucleic acid into the host cell.
    Step D   The host cell releases viral particles.
    Step E   The host cell produces viral nucleic acids and proteins.

23. Which of the following lists these steps in the order in which they occur in the life cycle of the virus?

    (a)   B – C – E – A – D
    (b)   A – E – C – D – B
    (c)   C – B – A – D – E
    (d)   D – C – E – B – A

24. Sea lions often huddle (crowd) together when on land. This behaviour helps to

    (a)   reduce heat loss because the surface area to volume ratio of the huddle is higher than that of individual sea lions.
    (b)   reduce heat loss because the surface area to volume ratio of the huddle is lower than that of individual seal lions.
    (c)   increase heat loss because the surface area to volume ratio of the huddle is higher than that of individual seal lions.
    (d)   increase heat loss because the surface area to volume ratio of the huddle is lower than that of individual sea lions.

25. The science of collecting and analysing large sets of biological data is called

    (a)   bioinformatics.
    (b)   biotechnology.
    (c)   comparative biochemistry.
    (d)   comparative genomics.

See next page

26. Some antibiotics kill bacteria by blocking ribosome function. This directly stops the bacteria from producing

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

27. Crossing over is the

   (a) exchange of alleles between homologous chromosomes.
   (b) exchange of alleles between non-homologous chromosomes.
   (c) segregation of homologous chromosomes to different poles.
   (d) segregation of non-homologous chromosomes to different poles.

28. Like humans, cattle have an XY system of sex determination. In cattle, a disease called AED is caused by a recessive allele at a gene on the X chromosome. Two cattle that do not have AED disease produce a male offspring with AED disease and a female without AED disease. What is the probability that the female offspring is a carrier of AED, i.e. has one copy of the AED allele?

   (a) 100%
   (b) 50%
   (c) 25%
   (d) 0%

29. In the course of an influenza epidemic, the number of susceptible hosts will

   (a) stay the same.
   (b) increase.
   (c) decrease.
   (d) fluctuate.

30. Homeostasis occurs in

   (a) animals only.
   (b) animals and plants only.
   (c) eukaryotes only.
   (d) prokaryotes and eukaryotes.

End of Section One

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.

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

Suggested working time: 90 minutes.

Question 31 (20 marks)

(a) DNA is made of units called nucleotides. Draw and label a diagram of a nucleotide.

(5 marks)

(b)   (i)   List the **two** sets of complementary base pairs that occur in DNA molecules.

(2 marks)

One:_____

Two: _____

(ii)   Name the type of chemical bond that links the complementary base pairs in a
       DNA molecule.   (1 mark)

_____

(iii) Name the base in mRNA that is complementary to thymine in DNA.   (1 mark)

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(c)   Describe the structure of mRNA.   (3 marks)

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(d)   Describe the role of tRNA in protein synthesis.   (4 marks)

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See next page

Question 31 (continued)

(e)   A study has shown that barn swallows living in an area contaminated by nuclear radiation have a high incidence of abnormalities compared with those in uncontaminated areas.

Provide a plausible explanation for the higher incidence of abnormalities in the barn swallows that live in the contaminated area. (4 marks)

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Question 32 **(20 marks)**

A group of biologists developed a model for predicting the spread of influenza in human populations. As a part of this, they collected data on the number of individuals per household in two locations, which are shown in the figure below.
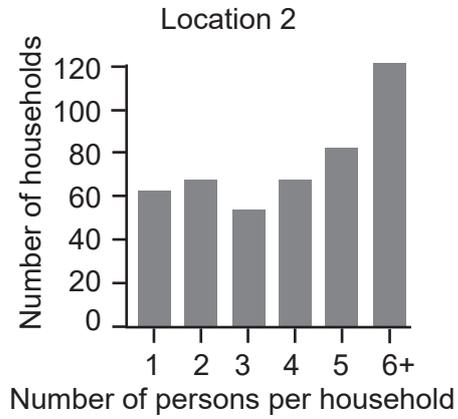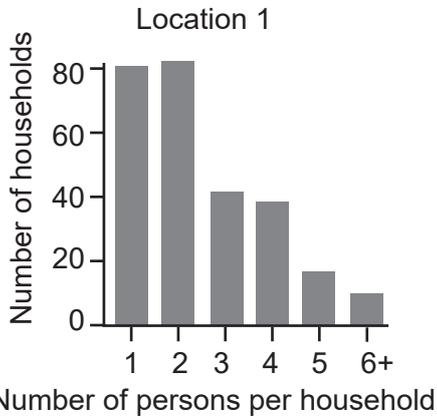
(a) Compare the number of people per household in the two locations. Use data from the figure to support your answer. **(4 marks)**

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(b) Explain why data on the number of people per household are relevant to the development of a model for predicting the spread of influenza in human populations. **(4 marks)**

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See next page

Question 32 (continued)

(c)   Can influenza be treated with antibiotics? Explain why or why not.   (4 marks)

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(d)   The Australian bat lyssavirus is a risk to human health. Explain why.   (4 marks)

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(e)   White spot disease is a highly-contagious viral disease in prawns. It is found in parts of Asia, America, Africa and the Middle East, but generally not in Australia. A recent outbreak has, however, occurred in several prawn farms on a river in Queensland.

Explain **two** measures that could be taken to reduce the risk of white spot spreading from the affected farms to other parts of Australia.   (4 marks)

One: _____

_____

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_____

Two: _____

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Question 33 **(20 marks)**

Biologists suspected that a species of fruit fly was developing resistance to a commonly-used insecticide. They collected 1000 fruit flies from an orchard sprayed regularly with this insecticide. In the laboratory they sprayed the fruit flies from the orchard with the recommended dose of insecticide and measured the percentage survival of the flies over the next 100 hours. At the same time, they also sprayed a group of 1000 laboratory-reared fruit flies of the same species that had never been exposed to insecticide and recorded their percentage survival over the next 100 hours. Fruit flies in both groups were kept under identical culture conditions. The data are shown below.

Time in hours since spraying	% fruit flies from the orchard surviving	% fruit flies from the laboratory surviving
0	100	100
20	97	8
40	51	4
60	50	2
80	49	2
100	49	0

(a) On the grid below, graph the percentage of fruit flies surviving over time for both the fruit flies from the orchard and those from the laboratory. (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.

(b)   (i)   State a hypothesis for the fruit fly experiment.   (2 marks)

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(ii)   Does the fruit fly experiment have a control? Explain your answer.   (3 marks)

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(c)   (i)   Calculate the number of flies from the orchard that died between 20 and 40 hours after being sprayed. Show your workings.   (2 marks)

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(ii)   Using your graph, estimate the time by which 50% of the fruit flies from the laboratory had died.   (1 mark)

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(iii)   Explain how you could modify the experiment to improve the accuracy of the estimate of the time by which 50% of the fruit flies from the laboratory had died.   (2 marks)

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See next page

Question 33 (continued)

(d) Biologists determined that resistance to the insecticide in the fruit flies was controlled by a single gene but were unsure whether the allele that gave resistance was dominant or recessive to the allele that caused susceptibility.

Describe how the biologists could determine whether the allele that gave resistance was dominant or recessive to the allele that caused susceptibility.   (4 marks)

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Question 34 **(20 marks)**

(a)   Indicate the order in which the following life forms first evolved: eukaryotic cells, prokaryotic cells, land plants and marine animals. (4 marks)

First (Oldest): _____

_____

Second: _____

_____

Third: _____

_____

Fourth: _____

_____

(b)   Distinguish between microevolution and macroevolution. Include a specific example of each in your answer. (4 marks)
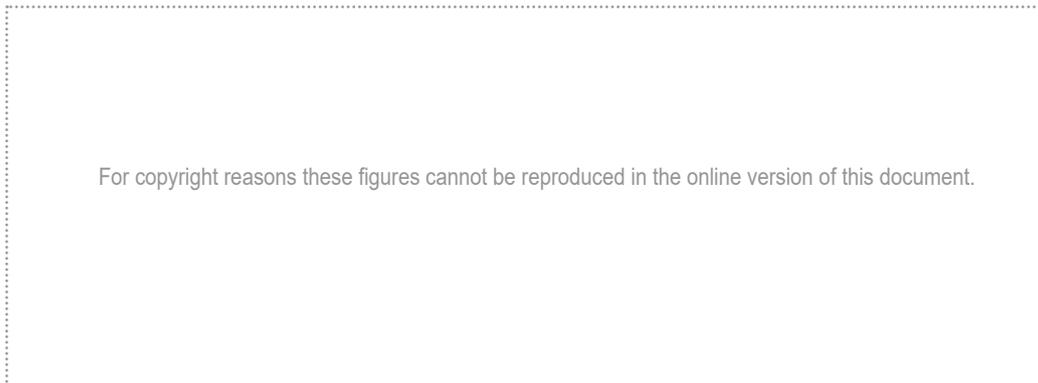
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See next page

Question 34 (continued)

Male red-collared widowbirds have very long tail feathers. In order to investigate the evolution of these feathers, a biologist cut the feathers of some male widowbirds and compared the mating success and body condition of these males to those of males with uncut, long tail feathers (control males). Figure 1 below shows the body condition index (where higher values indicate better condition) of the males with experimentally shortened feathers and the control males during the breeding season when the males were maintaining a territory. Figure 2 shows the mean number of active nests for the two types of male. This reflects the number of females that each male was able to attract to his territory.

Figure 1 **Figure 2**

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

(c) (i) Compare the body condition index for males with the experimentally-shortened feathers with that for the control males. (2 marks)

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(ii) Compare the number of active nests for the males with the experimentally-shortened feathers with that for the control males. (2 marks)

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(d)   Suggest a plausible explanation for the evolution of long tail feathers in the male
       widowbirds.   (5 marks)

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(e)   Large numbers of Australian herring inhabit estuaries on the south coast of Western
       Australia. The genetic compositions of the groups of individuals in the different estuaries
       are the same.

       Provide a plausible explanation for why this is so.   (3 marks)

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Question 35 **(20 marks)**

(a) List **four** distinctly different adaptations of plants to a dry environment. (4 marks)

One: _____

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Two: _____

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Three: _____

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Four: _____

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(b) Some desert mammals do not need to drink water. Explain how they can survive.

(4 marks)

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See next page

A biologist measured the rectal temperature (a reliable indicator of core body temperature) of a rabbit in an outdoor area every half-hour for three hours. The biologist also measured the temperature of the air and at the tip of one of the rabbit's ears. The data are shown in the table below.

		Time of day						
		13:00	13:30	14:00	14:30	15:00	15:30	16:00
Row A	Temperature (°C)	39.1	38.8	38.6	38.3	38.5	38.8	39.1
Row B	Temperature (°C)	26.7	27.2	28.9	24.2	21.3	20.7	20.0
Row C	Temperature (°C)	15.3	15.4	14.8	14.0	13.1	12.8	11.7

(c)   Which row in the table gives the rectal temperature for the rabbit? Explain your answer.

(4 marks)

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(d)   Rabbits have the ability to control the amount of blood flow to their ears. Explain how this can help them to thermoregulate.   (4 marks)

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See next page

Question 35 (continued)

(e) In many frog species the tadpoles excrete nitrogenous waste as ammonia, whereas the adult frogs excrete urea. Provide a plausible explanation for this. (4 marks)

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End of Section Two

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Section Three: Extended answer   20% (40 Marks)

Section Three consists of **four (4)** questions.

Questions 36 and 37 are from Unit 3. Questions 38 and 39 are from Unit 4. Answer **one (1)** question from Unit 3 and **one (1)** question from Unit 4.

Use black or blue pen for this section. Only graphs and diagrams may be drawn in pencil. Responses can include: labelled diagrams with explanatory notes; lists of points with linking sentences; labelled tables and/or graphs; and/or annotated flow diagrams with introductory notes.

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

Suggested working time: 50 minutes.

Unit 3

Choose **either** Question 36 **or** Question 37.

Indicate the question you will answer by ticking the box next to the question. Write your answer on pages 27–31. When you have answered your first question, turn to page 32 and indicate on that page the second question you will answer.

Question 36   (20 marks)

(a)   Chymosin is an enzyme produced by nursing calves to assist with the digestion of milk. Humans also use chymosin to make cheese. Traditionally, chymosin for cheesemaking was obtained from the stomach of calves that had been killed for their meat. It is now obtained from genetically-modified microorganisms.

Describe how recombinant DNA technology can be used to genetically modify bacteria to produce chymosin and the advantages of obtaining chymosin for cheesemaking in this way.   (10 marks)

(b)   In making conservation plans to maintain viable gene pools, why do biogeography, reproductive behaviour and population dynamics need to be considered?   (10 marks)

Question 37   (20 marks)

(a)   Describe the process of allopatric speciation.   (10 marks)

(b)   Explain how fossils, comparative anatomy, comparative embryology and comparative genomics can each provide evidence for the theory of evolution.   (10 marks)

See next page

Question number: _____

Question number: _____

Question number: _____

Question number: _____

Question number: _____

Question number: _____

Unit 4

Choose **either** Question 38 **or** Question 39.

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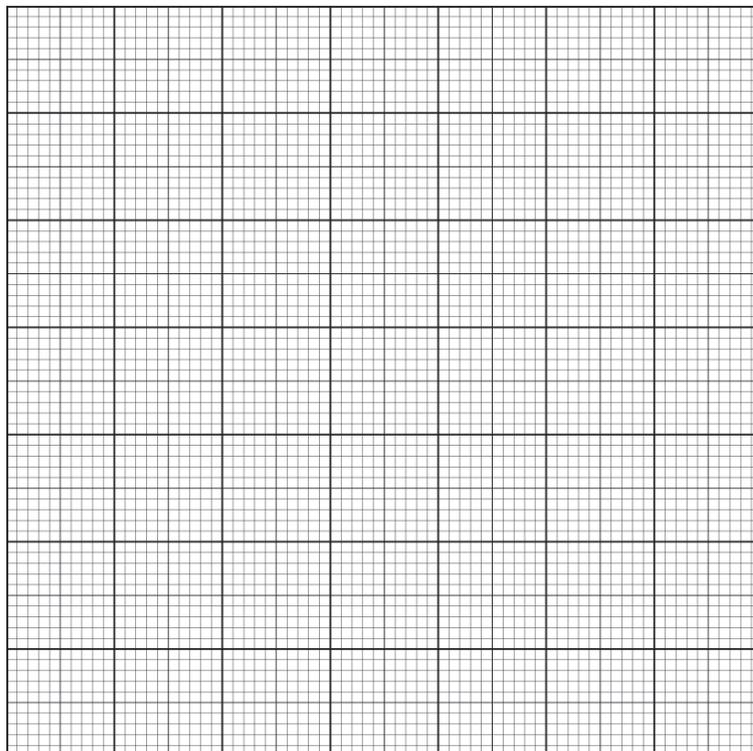

☐ **Question 38** **(20 marks)**

(a) Describe in general terms how an organism maintains its internal environment within tolerance limits. (10 marks)

(b) Explain how the spread of an infectious disease is influenced by the mode of transmission of the pathogen. Consider **three** distinctly different modes of transmission in your answer. (10 marks)

☐ **Question 39** **(20 marks)**

(a) Describe the life cycle of the pathogen that causes chytridiomycosis (amphibian chytrid fungus disease) and discuss the impact that the pathogen has on the host and the mode of transmission of the pathogen. (10 marks)

(b) Explain the problems that a bony fish experiences in maintaining water and salt balance in seawater and explain how the fish solves these problems. (10 marks)

End of questions

Question number: _____

Question number: _____

Question number: _____

Question number: _____

Question number: _____

Question number: _____

Supplementary page

Question number: _____

Spare grid

ACKNOWLEDGEMENTS