

Structure of this paper

Section	Number of questions available	Number of questions to be attempted	Suggested working time (minutes)	Marks available
A Multiple choice	30	30	40	60 (30%)
B Short answers	5	5	90	100 (50%)
C Extended answers	2	2*	50	40 (20%)
Total marks				200 (100%)

* Each question in Section C consists of four optional parts, of which **two** should be attempted.

Instructions to candidates

- The rules for the conduct of Tertiary Entrance Examinations are detailed in the booklet *TEE Handbook*. Sitting this examination implies that you agree to abide by these rules.
- Answer the questions according to the following instructions.

Section A Answer **all** questions, using a 2B, B or HB pencil, on the separate Multiple Choice Answer Sheet. Do **not** use a ball point or ink pen.

Section B Write your answers in the spaces provided in this Question/Answer Booklet. Do not answer this section in a Standard Answer Book. A blue or black ball point or ink pen should be used.

A blank answer page may be found at the end of this booklet. If you need to use it, indicate in the original answer space where the answer is continued (i.e. write "continued on page 31").

The space provided for each question is an indication of the length of answer required.

Section C Write your answers in the Standard Answer Book. Do not answer this section in this Question/Answer Booklet. Use a blue or black pen (not pencil) for this section. Do not copy the questions when answering; merely write the number of the question in the margin.

- At the end of the examination your Question/Answer Booklet should be attached to the **front** of the Standard Answer Book(s) with the paper binder provided.

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SECTION A (60 marks)

Suggested time: 40 minutes

Record an answer for Questions 1–30 by marking your choice of alternative on the separate Multiple Choice Answer Sheet using a 2B, B or HB pencil. Each question is worth two marks. Marks are not deducted for wrong answers.

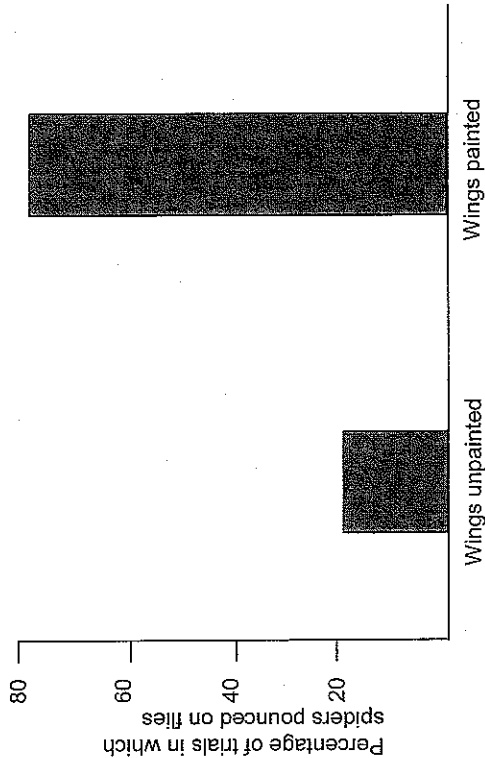
If you want to change an answer, rub out your first answer and mark the new choice. The answer sheet for Section A will be collected separately by the Supervisor.

- Conservation of natural ecosystems depends heavily on the setting aside of national parks and nature reserves. In desert areas these reserves need to be very large to be effective. In areas of higher rainfall smaller reserves can still be effective as a conservation strategy. What is the main reason for this difference?
 - Desert ecosystems have lower productivity and, therefore, lower population densities.
 - Deserts have greater biodiversity.
 - Desert organisms tend to move around much more.
 - There are more introduced pests in desert areas so larger reserves are needed to reduce their effect.
- Which of the following statements regarding cellular components is correct?
 - Protein synthesis occurs in the nucleus.
 - Golgi bodies are only found in plant cells.
 - Cilia move fluids over the surface of the cell.
 - Cell walls are structures that occur inside the plasma membrane.
- Jumping spiders do not spin webs, but instead stalk and pounce on prey just as cats do. Flies are a favourite food. Jumping spiders are also territorial animals and defend their territories by waving their legs at other spiders. Snowberry flies are the right size to be eaten by jumping spiders, but the spiders do not attack them very often. The snowberry flies have marks on their wings that look rather like spiders' legs. When a spider approaches, the flies wave their wings so the markings look like moving spiders' legs. A biologist suggested that these marks fooled the spiders into thinking that the flies were other spiders. Which of the following words best defines this suggestion?
 - It is an observation.
 - It is an hypothesis.
 - It is a theory.
 - It is a conclusion.

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Questions 4 and 5 relate to the following extra information.

Biologists reasoned that if this suggestion was correct snowberry flies with their wings painted to conceal the markings should be more likely to be attacked by spiders than unpainted flies. They painted the wings of some snowberry flies so that the markings that looked like spiders' legs were no longer visible. They then exposed these flies to jumping spiders. Another group of flies without painted wings was also exposed to the jumping spiders. The results are shown below.



4. What was the control in this experiment?

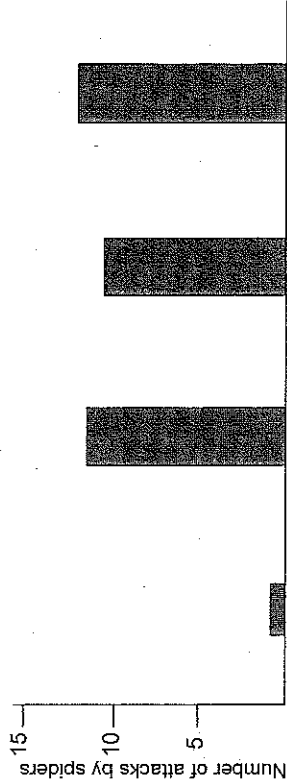
- (a) the species of fly used
- (b) the flies that weren't attacked by spiders
- (c) the flies with painted wings
- (d) the flies with unpainted wings

5. What is the dependent variable in the experiment?

- (a) the wings that were not painted
- (b) the wings that were painted
- (c) the percentage of flies attacked
- (d) the number of flies used in the experiment

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6. A second group of biologists designed a different experiment to investigate this question. They used both snowberry flies and houseflies which are a similar size and shape but lack markings on their wings and do not wave their wings. By grafting (transplanting) wings from snowberry flies to houseflies and from houseflies to snowberry flies they created four groups of flies: normal snowberry flies, normal houseflies, snowberry flies with housefly wings and houseflies with snowberry fly wings. They exposed each group to spiders. Their results are shown below.



Wing marks present?	Yes	No	No	Yes
Wing waving present?	Yes	No	Yes	No
	Snowberry fly	Housefly	Snowberry fly with housefly wings	Housefly with snowberry fly wings

What is the best conclusion from this experiment?

- (a) The spiders can tell the difference between snowberry flies and houseflies.
- (b) The wing markings and the waving of the wings are both important in reducing attacks.
- (c) Only the waving of the wings prevents attacks, not the markings.
- (d) No conclusion can be reached because there is more than one experimental variable.

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7. Which is the sequence of steps most commonly followed when carrying out a biological investigation?
- question, observation, hypothesis, prediction, experiment
 - question, hypothesis, prediction, experiment, observation
 - prediction, hypothesis, question, experiment, observation
 - observation, question, hypothesis, prediction, experiment
8. Which of the following statements best describes the relationship between chromosomes and genes?
- Mutations in chromosomes cause mutations in genes.
 - The behaviour of chromosomes during mitosis determines which genes are inherited.
 - There are more genes than chromosomes in a cell.
 - Chromosomes prevent mutations in genes.
9. Which one of the following statements is correct?
- An organism's genetic makeup is called its phenotype.
 - An organism with two identical alleles for the same trait is homologous.
 - Alleles are alternative forms of a gene.
 - All alleles on homologous chromosomes are different in heterozygous organisms.
10. Commercial chicken farmers go to great lengths to maintain a near-constant environmental temperature of around 30°C. What is the most likely reason for this?
- This temperature minimizes food intake.
 - The chickens' enzymes work best at this temperature.
 - The risk of disease is minimized because most disease causing organisms are ectothermic.
 - This is the body temperature of birds.

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11. An antibiotic kills 99.9% of a sample of bacteria in a culture, but the survivors increase in numbers and soon the population returns to its original level. Which of the following statements about this situation is most likely to be true?
- The new population will be just as susceptible to the antibiotic as the original population.
 - The antibiotic caused a mutation in some bacteria which helped them survive.
 - Bacteria in the new population will all be equally resistant to the antibiotic.
 - If the antibiotic is given to the new population, fewer than 99.9% of the bacteria will be killed.
12. Why are sex-linked recessive traits more common in men than women?
- Men acquire two copies of the recessive allele at fertilization.
 - Men need only one recessive allele on the X chromosome to display the trait.
 - All sex-linked traits are carried on the Y chromosome.
 - Sex chromosomes are inactivated in women.
13. A species of grasshopper may have black or orange eyes. Two black-eyed grasshoppers are crossed and they have these young:

	Black eyes	Orange eyes
Males	11	5
Females	9	1

Which of the following statements about the inheritance of eye colour is most likely to be true?

- The orange eye is inherited as a sex-linked recessive allele.
 - The orange eye is inherited as an autosomal recessive allele.
 - At least one of the parents was homozygous for eye colour.
 - None of the offspring could be heterozygous for eye colour.
14. Which of the following statements is the best example of an observation?
- The birds went to drink water at the same time each day.
 - The spider burrowed to avoid the heat.
 - The dolphin jumped out of the water to see the people in the boat.
 - The rat chewed each of the three balls to find if they were edible.

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15. Why are controls used in experiments?

- (a) to compare with an experimental group
- (b) to increase sample sizes
- (c) to ensure that the experiment could be replicated
- (d) to test the experimental hypothesis

16. The following table is one way to summarise the comparison between urban and natural ecosystems.

TYPE OF ECOSYSTEM	INPUTS	OUTPUTS	AMOUNT OF RECYCLING	STABILITY
NATURAL	S	U	W	Y
URBAN	T	V	X	Z

To complete the table with the words "more" or "less", which of the following would be true?

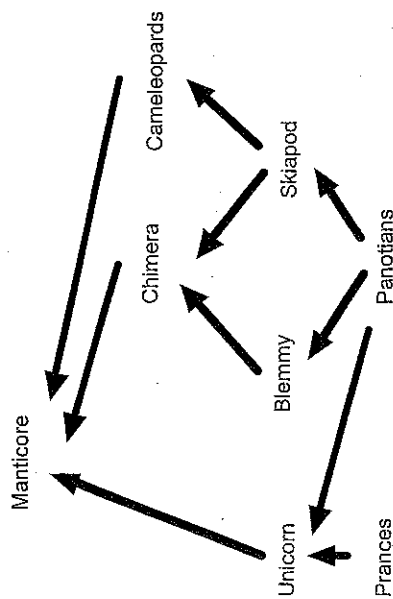
- (a) The word "more" would occur in boxes S, U, W and Y.
- (b) The word "more" would occur in boxes T, V, X and Y.
- (c) The word "less" would occur in boxes S, V, X and Z.
- (d) The word "less" would occur in boxes S, U, X and Z.

17. A species of primitive reptile (the tuatara) lives on small islands in New Zealand. Studies have shown that incubation of its eggs at 21°C or below produces only females. Incubation at 22°C or above produces only males. Surveys of island populations indicate that up to 70% of these animals are males. Scientists suspect that global warming is the cause and fear that extinction of the species may result. However, the species has survived for millions of years through wide temperature fluctuations caused by ice ages and movements in the earth's crust. What is the reason for the scientists' concerns?

- (a) The tuatara are isolated on small islands and are unable to interbreed.
- (b) Global warming may cause a rise in sea level, flooding some of the islands.
- (c) Changes associated with global warming have happened suddenly leaving little opportunity for the species to adapt.
- (d) With the abundance of males, some will not find a mate and the gene pool will be diminished.

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Questions 18–20 relate to the following diagram of a food web for a fictitious community occurring on a small island.



18. Food webs imply information about the biomass of the different organisms and the energy movements between them. Which of the following statements about the food web is correct?

- (a) Some of the biomass in the manticores may eventually be returned to the panotians.
- (b) Solar energy recycles through the food web.
- (c) Heat energy is gained at each step of the food web.
- (d) Total biomass increases at each step of the food web.

19. Which of the following statements about the biomass of the organisms in this food web is correct?

- (a) The biomasses of the unicorns, the blemmies and the skiapods will be equal.
- (b) The biomass of the skiapods will exceed the biomass of the cameleopards.
- (c) The biomass of the manticores will exceed the biomass of the panotians.
- (d) The biomass of the prances will equal the biomass of the panotians.

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20. A herbicide which is not biodegradable and accumulates in the body tissues of organisms is sprayed in this community and is absorbed into the body tissues of both the prances and the panotians. After several years of spraying, no ill-effects were noted in any members of the community. People living near the community were concerned that their pets might be poisoned if they ate any of the organisms in the community. Which of the following statements gives the best advice?

- (a) All organisms are likely to be fit to eat.
- (b) Only panotians and prances are likely to be unfit to eat.
- (c) Manicorees are likely to be the most dangerous to eat.
- (d) Unicorns, blemmies and skiapods are likely to be the most dangerous to eat.

21. Which of the following statements about ion and water balance in freshwater fish is correct?

- (a) Freshwater fish lose large amounts of water through their body surfaces.
- (b) Freshwater fish excrete ions through their gills.
- (c) Freshwater fish drink large amounts of water.
- (d) Freshwater fish produce large amounts of dilute urine.

22. Which of the following statements about the way endothermic animals regulate their body temperature is NOT correct?

- (a) The metabolic rate decreases during periods of inactivity.
- (b) The metabolic rate decreases in warm conditions.
- (c) The metabolic rate increases in cool conditions.
- (d) The metabolic rate increases during periods of activity.

23. A scientist has been studying photosynthesis in roses. After a warm weekend the scientist notices that the leaves on the roses have wilted. The scientist picks some leaves and finds that, after observing them under a microscope, the stomata are closed. The scientist concludes that the roses are suffering from water stress.

Which of the following statements BEST describes the effect of water stress on photosynthesis?

- (a) There is no effect on photosynthesis itself, but the lack of water in the xylem and phloem prevents transport of the products of photosynthesis to other parts of the plant, thus inhibiting growth.
- (b) The wilted leaves do not have sufficient surface area exposed to the sun to absorb light, thus preventing photosynthesis.
- (c) The closed stomata do not prevent gas exchange and therefore photosynthesis is not affected.
- (d) The closed stomata prevent gas exchange, resulting in carbon dioxide depletion and inhibition of photosynthesis.

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Questions 24 and 25 refer to the following diagram of a single cell viewed under 4 different magnifications under a microscope.

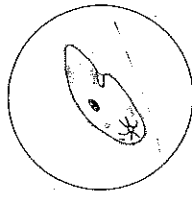


Diagram 1

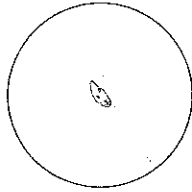


Diagram 2

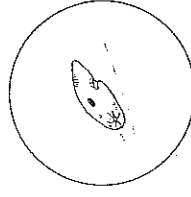


Diagram 3

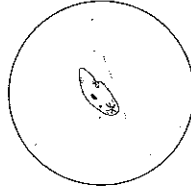


Diagram 4

24. In one of the diagrams the microscope was set on 400x magnification and in another diagram on 100x magnification. Which two diagrams represent these views?

- (a) Diagrams 1 and 4.
- (b) Diagrams 3 and 4.
- (c) Diagrams 2 and 3.
- (d) Diagrams 1 and 2.

25. The cell is known to have a length of approximately 50µm. Which of the diagrams has a field diameter of 0.3mm?

- (a) Diagram 1.
- (b) Diagram 2.
- (c) Diagram 3.
- (d) Diagram 4.

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In questions 26–29, what is the major process by which substances are moving across cell membranes?

26. A phosphate ion entering a root hair cell.

- (a) diffusion
- (b) osmosis
- (c) active transport
- (d) endocytosis

27. Oxygen entering a red blood cell.

- (a) diffusion
- (b) osmosis
- (c) active transport
- (d) endocytosis

28. A red blood cell is placed in a highly concentrated salt solution.

- (a) diffusion
- (b) osmosis
- (c) active transport
- (d) endocytosis

29. An amoeba consuming a bacterial cell.

- (a) diffusion
- (b) osmosis
- (c) active transport
- (d) endocytosis

30. Tortoises are terrestrial reptiles related to turtles. Some tortoises can produce both urea and uric acid as nitrogenous waste products. Which statement about tortoises is the best explanation of this adaptation?

- (a) The tortoises' diet causes them to have such large amounts of nitrogenous waste that they need to produce both compounds to excrete it all.
- (b) Tortoises produce urea to repel predators but otherwise use uric acid.
- (c) The tortoises excrete urea when food is plentiful and they have sufficient energy to produce it. They then switch to producing uric acid when food is scarce and they need to conserve energy.
- (d) The tortoises only excrete uric acid during drier months to conserve water and switch to urea during wetter periods.

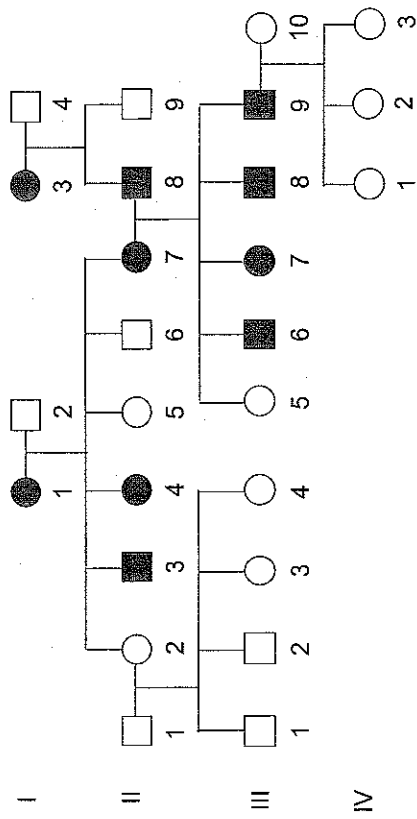
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SECTION B (100 marks)

(Suggested time: 90 minutes)

Attempt all questions in this section. Write answers in the spaces provided in this booklet. If you need extra space you may use the spare pages at the end of this booklet; do not write answers to Section B in the Standard Answer Book. Use black or blue ink or ball point pen.

31. The pedigree below shows the pattern of inheritance of a heart disease in sheep. It causes no problems with younger sheep but weakens older animals.



(a) Using symbols of your own choosing and evidence from the pedigree, explain clearly the mechanism of inheritance of the heart disease.

(4 marks)

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- (b) Indicate the likely genotype(s) of the following four individuals.

(i) I 2.

(ii) II 7.

(iii) III 4.

(iv) III 8.

(4 marks)

- (c) The farmer plans to cross II 4 and III 2.

(i) What is the probability that their first offspring will have the disease?
Show your working.

(ii) What is the probability that their second offspring will be a normal male?
Show your working.

(4 marks)

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- (d) The farmer wishes to know whether individual III 6 is homozygous or heterozygous.
How could she determine this? Show your working.

(4 marks)

- (e) After examining the pedigree, another farmer becomes suspicious regarding individual III 5. He argues that individual III 5 could not be the offspring of II 7 and II 8 because their other four offspring show the trait. Is he right? Explain your answer, showing your working.

(4 marks)

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32. Populations of snakes can be found on small, offshore islands. Studies have shown that their only source of food is the eggs and chicks of birds nesting on the island. The birds' nesting season lasts for two months of the year and the snakes starve for the rest of the year, completing their reproductive cycle. Only during the coldest months are they inactive.

- (a) Explain why the snakes are able to survive without food for such a long period when a mammal would usually die.

(4 marks)

- (b) A diet of eggs and birds leads to a high level of nitrogenous wastes in the body of the snake.

- (i) Which component of the snakes' diet leads to the high levels of nitrogenous wastes?

- (ii) Name the three types of nitrogenous wastes produced by animals, in order from the most toxic to the least toxic.

1. _____ Most toxic

2. _____

3. _____ Least toxic

(4 marks)

- (c) (i) Which type of nitrogenous waste would snakes excrete?

- (ii) List three ways in which this would help with the snakes' survival.

(4 marks)

- (d) The snakes have never been observed to drink seawater, however the birds on which they feed are able to drink seawater without any ill effects.

- (i) Explain the likely osmotic effect of seawater on the body cells of animals which drink it.

- (ii) In general terms, what would a bird's body need to do to successfully gain body water from seawater?

(4 marks)

The study of these snakes also has found that they are significantly larger than mainland snakes of the same species.

(e) Provide one reason why this could help the snakes with water shortages, and one reason why this could help the snakes with food shortages.

(i) Water shortage

(ii) Food shortage

(4 marks)

33. Grasses form a major part of agricultural pastures around the world. In drier parts of the world these grasses are annuals, meaning that they complete their life cycle in one season, produce seed and die. The seeds germinate in wet seasons of following years to renew the pasture. Some seeds germinate the very next year but others remain dormant for up to several years before germinating.

A scientist investigated the dormancy rates for seeds of three different species of annual grass. Two grams (2 g) of seed of each species were planted in separate square metre plots. No other plant species was present in the plots. Each year for six years the number of seeds that germinated in each plot was counted. The seedlings were then removed so that no new seeds were produced in the plots. The results of this experiment are shown in the table below.

GRASS SPECIES	TIME ELAPSED (YEARS)					
	1	2	3	4	5	6
A	610	320	NO READING	140	20	5
B	415	35	0	0	0	0
C	380	100	35	15	10	NO READING

NUMBER OF SEEDS GERMINATED (No. per m²)

(a) On the grid provided, draw a line graph of these data for each of the 3 grass species. (If you wish to have a second attempt at this item, the grid is repeated at the end of the examination booklet. Indicate clearly on this page if you have used the second grid and cancel the working on the grid on this page).

[illegible]

(4 marks)

For species A in year 3 and species C in year 6 valid measurements were not taken because of unexpected interference with the plots.

- (b) Use the graph that you have drawn to predict likely values for these readings had it been possible to measure them.
- (i) Species A year 3 _____
Species C year 6 _____
- (ii) In which prediction do you have greatest confidence? Explain why.

(4 marks)

- (c) For the experiment described, name
- | | |
|------|---|
| (i) | the dependent variable. |
| (ii) | two variables that would have been only due to seed dormancy. |

(4 marks)

All plots were planted with equal amounts of seed (2 g per m^2), yet very different numbers of plants grew in each plot.

- (d) Give two possible reasons to explain this.

(i)

(ii)

(4 marks)

In severe drought years grass seeds germinate when it rains but fail to mature, dying before they produce seed. In the year following a severe drought year pasture growth depends largely on dormant seeds in the soil that are least two years old.

- (e) (i) In a period of extended drought (two or more years) which of the three species of grass would suffer the greatest reduction?

- (ii) Give an explanation for your answer above.

(4 marks)

34. European settlement in Australia has had a range of harmful effects on the environment. Widespread clearing of land for agricultural purposes has had a serious impact.

- (a) Name four environmentally harmful effects of widespread land clearing.

(4 marks)

Introduced species are another major problem that came with European settlement. Grasses and other weeds have escaped from farms to establish themselves in bushland.

- (b) Briefly explain two different ways these non-native plants can harm natural ecosystems.

(i)

(ii)

(4 marks)

- (c) To combat introduced pests, scientists sometimes use a strategy called biological control.

(i) Briefly explain what is meant by biological control.

(ii) List three precautions that must be taken to ensure biological control does not get out of control itself.

(4 marks)

Another problem is caused by the fertilisers used in agriculture and gardens. In particular, phosphate fertiliser can kill native plants that require little phosphate and it also causes toxic algal blooms in waterways. Part of the problem is caused by the fact that roadside drains in urban areas drain into waterways, carrying with them anything that goes down the drains.

- (d) Name four actions that householders can take to help minimise nutrient pollution of roadside drain water.

(i) _____

(ii) _____

(iii) _____

(iv) _____

(4 marks)

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- (e) List four reasons why it is important to conserve our native biodiversity.

(4 marks)

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35. Cells use a range of structures and processes to regulate their metabolism and interact with their environment.

(a) Give two reasons why all organisms need each of the following.

(i) DNA

(ii) enzymes

(4 marks)

- (b) ATP is an important molecule for energy flow in living organisms. List four functions that ATP performs in cells.

(4 marks)

- (c) Although all animals need oxygen to survive, some can withstand a lack of oxygen for long periods.

(i) Name the metabolic process for obtaining energy from the breakdown of organic compounds in the absence of oxygen.

(ii) Compare the amount of ATP produced from glucose in the presence and absence of oxygen.

(iii) Name the end products from the breakdown of glucose in the presence of oxygen in a mammal.

(iv) Name the end products from the breakdown of glucose in the absence of oxygen in a mammal.

(4 marks)

(d) Photosynthesis is the basis of almost every ecosystem on earth.

(i) Define photosynthesis.

(ii) List the raw materials of photosynthesis.

(iii) What is the function of chloroplasts?

(iv) What are the products of photosynthesis?

(4 marks)

(e) Some photosynthetic and heterotrophic organisms live in a mutualistic relationship. This is a type of relationship from which both organisms benefit. An example of this is found in many hard corals. The coral animals harbour small, single-celled photosynthetic algae within their cells.

(i) Suggest two processes of the coral animal that are assisted by materials obtained from the photosynthetic algae.

(ii) Suggest two benefits that the photosynthetic algae obtain from living inside the cells of the coral animal.

(4 marks)

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Suggested time: 50 minutes

SECTION C (40 marks)

ANSWER SECTION C IN THE STANDARD ANSWER BOOK

(Note: You are now reading your Question/Answer Booklet. This is NOT the same as a Standard Answer Book.)

SECTION C consists of two questions, 36 and 37. There are four parts to each question. You must answer **two** parts from 36 and **two** parts from 37. Each part carries ten (10) marks.

Question 36 mainly tests your **knowledge** of syllabus content. Question 37 mainly tests **how you apply** your understanding of biological principles.

Answers may be presented in different ways provided they communicate your ideas effectively. You may choose to:

- present a clearly labelled diagram;
- write notes beside a clear diagram;
- write lists of points, with sentences which link them;
- write concisely worded sentences;
- use some other appropriate way to present ideas.

Marks may be deducted for answers which are poorly presented or difficult to read. Use black or blue pen or ball point for written answers and pencil for diagrams.

Question 36

Answer any two questions from 36(a) to 36(d). (10 marks for each)

36(a) Using labelled diagrams, describe mitosis in terms of division of chromatids. Explain the need for DNA replication in the cell cycle.

36(b) Using examples of natural selection in action, explain how selective forces in the environment contribute to evolutionary change.

36(c) Explain the concept of an ecosystem, describing the major components. Explain how ecosystems are interlinked to form a biosphere.

36(d) Describe the processes by which terrestrial animals and terrestrial plants maintain water balance.

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Answer any two questions from 37(a) to 37(d). (10 marks for each)

37(a) The desert-grassland whiptail is an insect-eating lizard that lives in dry prairies and grasslands of the southwestern United States and northern Mexico. It is unusual because there are no males in the population and the females reproduce entirely by parthenogenesis, a process in which a diploid egg, produced by mitosis, develops into a new individual without fertilization.

- (i) Explain the genetic consequences for the desert-grassland whiptail of the absence of fertilization.
- (ii) Would the desert-grassland whiptail be best suited to a stable environment or to a changing environment? Explain your answer.

37(b) Describe with the aid of diagrams

- (i) the structures and processes by which water is absorbed by root hairs, travels through the plant and exits the plant via the stomates.
- (ii) how the leaves of a desert-dwelling plant might be expected to differ from those of a plant growing in a moister environment.

37(c) All living organisms on earth are composed of one or more cells. All cells have certain characteristics in common while other characteristics show enormous variety.

Identify and describe briefly:

- (i) cellular features that reflect the common evolutionary origin of cells;
- (ii) cellular features that reflect the specialisations of cells.

37(d) Humpback whales weigh up to 65,000 kg, about as much as 70 mid-size cars. They primarily eat small crustaceans called krill which they filter from the seawater using brushlike plates called baleen, located on each side of their upper jaw. The humpback whales are at the end of a very short food chain in which small autotrophs (phytoplankton) are the producers, krill are first order consumers and the whales are second order consumers.

- (i) From your knowledge of energy flow in ecosystems, suggest why humpback whales are able to grow so large.

Extinct large sharks called *Megalodon* are believed to have preyed on primitive whales.

- (ii) Would the biomass of *Megalodon* have been larger, smaller or about the same as the biomass of its prey? Explain your answer.

END OF PAPER

Check that you have written your Student Number on the front cover of this booklet and on the Standard Answer Book(s).

SPARE WORKING SPACE FOR SECTION B ONLY
Do not answer Section C in this booklet.