Structure of this paper

Section		Number of questions available	Number of questions to be attempted	Suggested working time (minutes)	Marks available
A	Multiple choice	1-30	All	40	60 (30%)
B	Short answers	31-35	All	90	100 (50%)
C	Extended answers	36*	Two parts	50	40 (20%)
		37*	Two parts		
				Total marks	200

*Questions 36 and 37 each consist of four optional parts, of which **two** should be attempted in each question.

Instructions to candidates

1. 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.

2. 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.

   Spare answer pages may be found at the end of this booklet. If you need to use them, indicate in the original answer space where the answer is continued (i.e. give the page number).

   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.

3. 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 Multiple Choice Answer Sheet for Section A will be collected separately by the Supervisor.

---

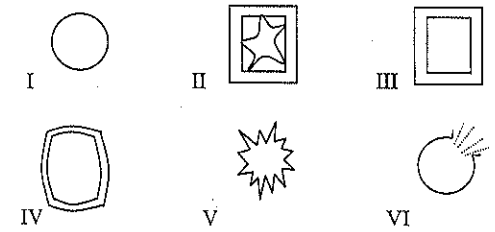
1. What is the major site of aerobic respiration in cells?

   (a) The nucleus.
   (b) The flagellum.
   (c) The mitochondria.
   (d) The Golgi apparatus.

2. Which of the following statements about aerobic and anaerobic respiration is correct?

   (a) During anaerobic respiration more energy is extracted from fuel molecules than during aerobic metabolism.
   (b) Both processes occur in the cytoplasm and compete for fuel substances with each other.
   (c) Only cells living in oxygen-free environments use anaerobic respiration, all other organisms rely on aerobic respiration alone.
   (d) The end products from anaerobic respiration are more toxic to cells than the end products of aerobic respiration.

3. The following diagrams represent cells after one hour in solutions of different concentrations of salt.



   The concentration of salt in which pair of cells is greater than the concentration of salt in their environment?

   (a) I and II
   (b) IV and VI
   (c) III and V
   (d) II and VI

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4. Decide whether the following statement is true or false, and why. "All of life on earth is ultimately dependent on producers."

(a) This statement is true, because only producers convert simple inorganic substances to complex organic substances.
(b) This statement is true, because producers do not use oxygen that consumers depend on.
(c) This statement is false, because some organisms feed on dead matter only.
(d) This statement is false, because producers are more primitive than consumers.

5. Mitosis is the division of a cell's nucleus into two daughter nuclei. Which of the following statements about mitosis is correct?

(a) The two daughter nuclei each carry half as many chromosomes as the original nucleus.
(b) The DNA in each of the daughter nuclei is an identical copy of the DNA in the original nucleus.
(c) Each daughter nucleus carries twice as much DNA as the original nucleus.
(d) The two daughter nuclei each have twice as many chromosomes as the original nucleus.

6. All animals produce nitrogenous waste products that need to be excreted. There are three types of nitrogenous waste products produced by animals:

Ammonia	Decreasing
Urea	solubility
Uric acid	▼ in water

Based on this information, select the correct statement.

(a) Because of the need to conserve water in a desert environment reptiles produce uric acid.
(b) Mammals urinate frequently so they produce ammonia.
(c) Birds need to keep their body weight down for flight so they produce ammonia.
(d) Fish need to reduce the amount of water in their bodies so they produce uric acid.

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7. The Giant Gippsland earthworm grows to about a metre in length and spends most of its time in underground burrows just like other earthworms. Uptake of oxygen and release of carbon dioxide in earthworms occurs through their skin. You decide to investigate this remarkable animal further and place these earthworms in artificial burrows designed to measure oxygen uptake and carbon dioxide production. The burrows are sealed off from the outside air, to simulate the underground burrows the animals naturally inhabit. To your amazement you observe that, as the earthworms spend longer in the artificial burrows, they increase their body length. Select one of the following statements as the most likely explanation for this behaviour.

(a) The earthworm has used up all the oxygen in the burrow and has died from oxygen starvation.
(b) The earthworm increases its surface area so as to be able to absorb the dwindling oxygen left in the burrow.
(c) The earthworm is trying to cool down faster to reduce its metabolic rate.
(d) The earthworm had initially contracted its body and is now relaxed.

8. Which is the correct path of water transport in plants, listed from uptake into the plant to exit from the plant?

(a) Roots, root hair cells, phloem tissue, leaves, stomata.
(b) Root hair cells, roots, phloem tissue, leaves, stomata.
(c) Stomata, leaves, xylem tissue, roots, root hair cells.
(d) Root hair cells, roots, xylem tissue, leaves, stomata.

9. Vascular plants adapted to live by floating on water are most likely to show which of the following adaptations?

(a) No stomata on the leaves
(b) Stomata on stems as well as leaves
(c) Stomata located in pits on the leaves
(d) Stomata located on the upper surface of the leaves

10. Which process is mostly responsible for moving water to the top of a tree?

(a) Cohesive forces between water molecules
(b) Evaporation of water from the leaf
(c) The force of root pressure
(d) Osmosis in the root hair cells

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11. Which of the following would be the best way of describing water movement in a tree trunk?

(a) Scooping water with a bucket.
(b) Turning on a garden hose.
(c) Pumping blood with a heart.
(d) Drinking through a straw.

12. What is the final fate of most of the energy that enters an ecosystem?

(a) It will be recycled between trophic levels.
(b) It will be transferred to decomposers.
(c) It will be used in photosynthesis.
(d) It will be radiated from the ecosystem as heat.

13. What term best describes a human eating a watermelon?

(a) Primary (1st order) consumer
(b) Secondary (2nd order) consumer
(c) Producer
(d) Decomposer

14. Which of the following statements about the base of a biomass pyramid in a woodland would be true?

(a) It represents the energy available to secondary consumers.
(b) It receives energy from the primary consumers.
(c) It contains the energy fixed by photosynthesis.
(d) It contains the energy left after the producers have died.

15. Ecosystems can be described as natural, agricultural or urban. Which of the following statements about these kinds of ecosystem is correct?

(a) Natural ecosystems recycle little organic waste.
(b) Urban ecosystems do not rely on solar energy but natural ecosystems do.
(c) Recycling does not occur in urban ecosystems.
(d) Agricultural ecosystems produce less heat waste than urban ecosystems.

16. Which of the following statements best describes an ecosystem?

(a) All species occurring in a particular environment.
(b) A community together with the physical environment with which its members interact.
(c) All the communities of a large, distinct area such as an island or a continent.
(d) Every species in the biosphere.

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17. Lantana is an attractive ornamental plant which was introduced to Australia from Mexico. It is hardy and drought-tolerant, making it well suited to Australian conditions. However, it escaped from gardens and is now a serious environmental weed. Some biologists have suggested that biological control should be attempted. What would be the best strategy to seek effective biological controls for lantana?

(a) Search Mexico and neighbouring countries for potential control organisms.
(b) Identify Australian plants most closely related to lantana.
(c) Identify unhealthy lantana plants in Australia.
(d) Create mutations in other biological controls to suit them to lantana.

18. Caves contain no natural light of their own, yet they often have rich communities of organisms. Which of the following organisms would be the producers for cave communities?

(a) Plants outside the cave.
(b) Bats living in the cave.
(c) Fungi and mould lining the cave.
(d) Bacteria growing in the cave.

19. Landslides isolate the people in a small village in a mountain valley. A stream provides fresh water, but the people are concerned that the food supply might not last until they are rescued. However, they do have a store of wheat and several cows. What should they do in the short term to use the food most effectively?

(a) Feed the wheat to the cows and drink the milk.
(b) Eat the cows and then the wheat.
(c) Eat the wheat and then the cows.
(d) Plant the wheat to grow more food.

20. The following question refers to the table below showing the surface area and volume of three different endothermic animals labelled I, II and III.

	I	II	III
Total surface area	96	384	488
Total volume	64	64	64

Which animal(s) would need the most food in a cold climate and why?

(a) I, because its shape would cause it to lose heat most rapidly.
(b) II, because its shape would cause it to lose heat most rapidly.
(c) III, because its shape would cause it to lose heat most rapidly.
(d) They all need the same amount of food as they have the same volume.

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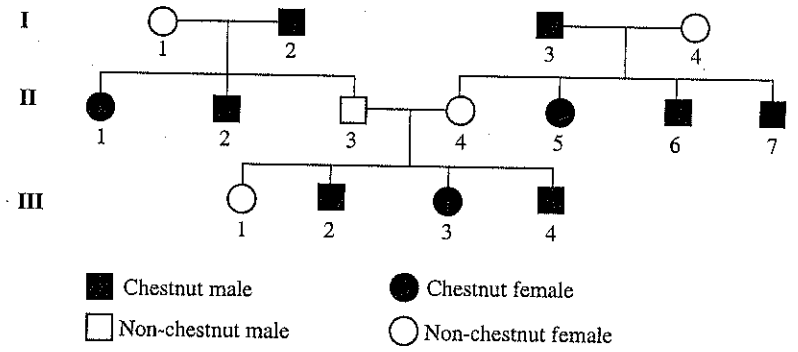
21. During spring in southern Australia reptiles such as lizards and snakes become active after a period of winter dormancy. Initially, they are most active during the daytime. By mid-summer they are most active at night. Which of the following is the best explanation of this?

(a) They are hungry in spring after being dormant for so long.
(b) They mate in spring and lay eggs in summer.
(c) The day temperature determines their active period.
(d) In summer they are conserving energy for the cold winter months.

Questions 22 and 23 refer to the following pedigree showing the inheritance of chestnut (red/brown) coat colour in horses.



22. Sex (male or female) in horses is inherited in the same way as humans. Therefore, which one of the following statements is true?

(a) Individual III 4 must have inherited a Y chromosome from I 2.
(b) Individual III 1 must have inherited an X chromosome from I 4.
(c) Individuals III 1 and III 3 must have identical genes on their X chromosomes.
(d) Individuals II 2 and II 3 must have different genes on their Y chromosomes.

23. From this pedigree it can be concluded that chestnut coat colour in horses is inherited as which of the following?

(a) A dominant autosomal gene.
(b) A recessive sex-linked gene.
(c) A recessive autosomal gene.
(d) A dominant sex-linked gene.

24. The use of rats for scientific purposes is strictly regulated in educational and research institutions. On the other hand, rat baits are freely available to anyone in any supermarket. From an ethical point of view which of the following is the best justification for this apparent conflict?

(a) Benefits of rat control are well known but research must be justified in advance.
(b) Laboratory rats are pets while wild rats are not.
(c) Wild rats carry disease while laboratory rats are disease free.
(d) The laws need to be changed to ban rat baits.

25. In the common honey bee (*Apis mellifera*) the queen mates with one or more male bees. In this process the male transfers large amounts of semen into sacs in the body of the queen. From then on she can fertilise her own eggs whenever needed. Which of the following is a true statement about this form of honey bee reproduction by fertilised eggs?

(a) It is sexual reproduction but it also involves self fertilisation.
(b) It is asexual reproduction because the actual process of fertilisation involves only one parent.
(c) It is sexual reproduction because fertilisation is involved.
(d) It is asexual reproduction because the mating process does not immediately result in fertilisation.

The form of reproduction described above only produces female worker bees. To produce male bees the queen lays unfertilised, haploid eggs, which are still able to develop and hatch.

26. Which of the following statements comparing body cells of male and female bees would you expect to be true?

(a) Male cells would contain half as many chromosomes but they would still be in homologous pairs.
(b) Male cells would contain half as many chromosomes and none would be homologous.
(c) Male cells would contain the same number of chromosomes but none would be homologous.
(d) Male and female cells would both contain the same number of chromosomes and these would be homologous pairs.

27. Which of the following **cannot** be used as evidence for the theory of evolution?

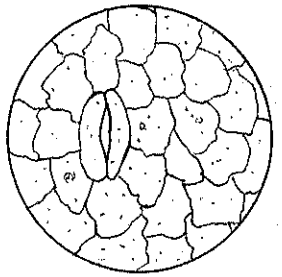
(a) Fossils have been found that show a pattern of change over time in a type of organism.
(b) Many related animals (e.g. lion and tiger) have very strong similarities in their DNA.
(c) Many organisms possess structures that are no longer as functional as they are in other species (e.g. human tail bones compared to a dog's tail bones).
(d) Organisms generally resemble their parents more closely than they resemble other members of their species.

28. Which of the following statements about frogs is most likely to be an inference?

(a) Frog numbers are declining world-wide.
(b) Frogs have moist skin.
(c) All green tree frogs are found in trees.
(d) Frogs can change the colour of their skin.

Please note that Questions 29 and 30 are related.

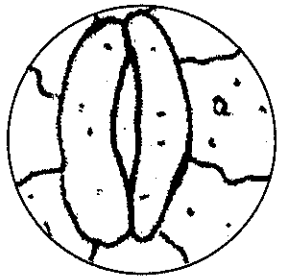
29. A student used a microscope to observe a stomate on a leaf epidermis. With a 10x ocular lens and a 20x objective lens the following view was seen through the microscope.



If the stomate, including the guard cells, is known to be 50 μm wide, which of the following is the closest estimate of the field diameter?

(a) 0.25 mm
(b) 0.5 mm
(c) 1.5 mm
(d) 2.5 mm

30. The student altered the lens combination of the microscope and observed the following view of the same section of the same slide.



Which new lens combination would be most likely to provide this view?

(a) A 15x ocular and a 40x objective.
(b) A 10x ocular and a 30x objective.
(c) A 10x ocular and a 40x objective.
(d) A 20x ocular and a 25x objective.

SEE NEXT PAGE

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. Mammals and birds maintain constant body temperatures in fluctuating environmental temperatures by regulating their metabolic rate. In contrast, the metabolic rate of reptiles is determined by their body temperature, which, in turn, depends on environmental temperatures.

(a) Name two mechanisms by which large endothermic animals maintain a fairly constant body temperature

(i) in hot weather.

_____

_____

(ii) in cool weather.

_____

_____

(4 marks)

(b) Name two mechanisms an ectothermic animal uses to

(i) lower its body temperature in hot weather.

_____

_____

(ii) raise its body temperature in cool weather.

_____

_____

(4 marks)

SEE NEXT PAGE

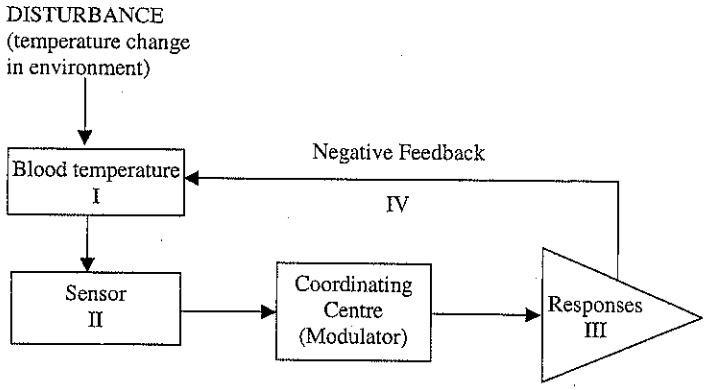
Question 31 (continued)

(c) Construct a table comparing two advantages and two disadvantages of ectothermy and endothermy.

	Advantages	Disadvantages
Ectothermy		
Endothermy		

(4 marks)

(d) Examine the following diagram of the stimulus-response-negative feedback for temperature regulation in an endotherm. Briefly state what would happen at I, II, III and IV if the environmental temperature decreased suddenly.



I _____

II _____

III _____

IV _____

(4 marks)

(e) Estuarine crocodiles are reptiles which live in the regions of tropical Australia shown in black on the map below. They grow to more than 6 m in length. Their body temperatures over a 24 hour period are found to be relatively constant and can be considerably higher than night time air and water temperatures. Water dragons are also reptiles. They grow to about 1 m in length and live in similar environments to the crocodiles. In contrast to the crocodiles, the body temperature of water dragons is much more similar to air and water temperatures, particularly at night.

■ Regions where estuarine crocodiles are found.

(i) Explain why the body temperature of crocodiles does not fluctuate as much as the body temperature of water dragons.

_____

_____

_____

_____

_____

(ii) On the basis of this observation of the relatively constant body temperature of crocodiles, explain the restriction of this large reptile to tropical Australia as shown on the map.

_____

_____

_____

_____

_____

(4 marks)

32. Cells use chemical reactions to grow and reproduce. Enzymes are involved in almost all of the chemical reactions that take place in cells. Some of the characteristics of enzymes are a 'lock and key' mechanism of action and sensitivity to pH and temperature.

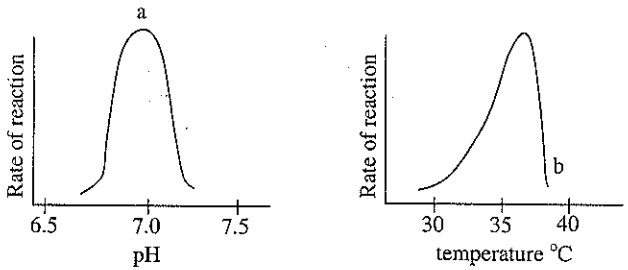
(a) Name four other features of enzymes.

(4 marks)

(b) By means of a series of labelled diagrams, illustrate the 'lock and key' hypothesis for enzyme action.

(4 marks)

(c) Below are two representations of the effect of pH and temperature on the rate of reaction catalysed by a particular enzyme.



(i) Explain the rate of reaction at points a and b on the graphs in terms of the shape of the enzyme.

(ii) On the basis of the information in the graphs, what can you say about the ability of this enzyme to catalyse reactions under different conditions.

(4 marks)

Question 32 (continued)

(d) Lysosomes are organelles that contain many enzymes that are used in digestion (hydrolysis) of food particles and breakdown of old organelles.

Cell component	pH
Lysosome	5
Cytoplasm	7

(i) Using the information in the table above, explain why the cell is not destroyed by accidental leakage of lysosomal enzymes.

(ii) Some cells are programmed to self-destruct at a certain time. Suggest how cells might achieve this using lysosomal enzymes.

(4 marks)

(e) Prokaryotic cells such as bacteria lack subcellular compartments (organelles). From your understanding of enzyme function, describe one advantage and one disadvantage of not having organelles.

(4 marks)

33. (a) A geneticist studied a grass species growing in an area of variable annual rainfall. She found that some plants had curled leaves, while others had flat leaves. She removed some plants to two glasshouses, one containing only curled leafed plants and the other containing only flat leafed plants.

She allowed the plants to interbreed within each glasshouse but not between the glasshouses. She then noted the characteristics of the offspring.

Cross	Offspring
Curled leafed x curled leafed	All with curled leaves
Flat leafed x flat leafed	240 flat leafed plants, 30 curled leafed plants

State the method of inheritance by which you believe leaf type is inherited. Explain your reasoning using symbols of your choosing.

(4 marks)

(b) A pure-breeding curled leafed plant is crossed with a pure-breeding flat-leafed plant. On the basis of the method of inheritance you stated above, answer the following questions.

(i) What genotype(s) and what phenotype(s) are possible in the offspring?

(ii) The offspring from the above cross are allowed to interbreed. What genotype(s) and what phenotype(s) are possible in the offspring?

(4 marks)

Question 33 (continued)

(c) This grass species can reproduce by flowering and cross-pollination, or by cutting a portion of grass with roots from a parent and planting it elsewhere. Suppose a cutting was taken from a flat leafed plant that is not pure-breeding.

(i) When it matures, will it show curled or flat leaves? Explain your answer.

(ii) What advantages does the plant gain by reproducing both by cuttings and by flowering?

(4 marks)

(d) In this area rainfall has been observed to be increasing over several years. The geneticist noticed that in years with low rainfall, many of the plants with flat leaves died before reproducing. In the following years, most of the population had curled leaves.

In years with high rainfall both flat-leafed and curled-leafed plants had an equal chance of survival, but the flat-leafed plants produced many more seeds. Thus after a number of years of high rainfall most of the population had flat leaves.

Are these observations an example of natural selection? Explain your answer.

(4 marks)

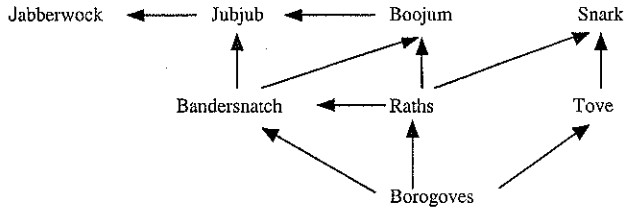
(e) The geneticist wished to develop a pure-breeding strain of the dominant phenotype of this plant. A friend suggested she should do this by interbreeding dominant plants, destroying any recessive offspring and breeding only from the dominant offspring.

(i) Explain why this suggestion would not work.

(ii) Suggest how the geneticist could develop a pure-breeding strain of plants with the dominant phenotype.

(4 marks)

34. The diagram below shows a complete food web for a fictitious community occurring on a small island.



(a) (i) Name all foods of the jubjub in this food web.

(ii) Name all consumers eating borogoves in this food web.

(4 marks)

(b) The food web consists of several different food chains.

(i) From the food web, draw a food chain containing six organisms.

(ii) Name the organism that would have the greatest biomass in the food chain you drew and name the organism that would have the least biomass in the food chain you drew.

(iii) It is rare for food chains to involve more than five organisms. Explain why this is so.

(4 marks)

(c) A long drought on the island killed nearly half the borogoves.

(i) What will be the likely consequence for the bandersnatch population? Explain your answer.

(ii) What will be the likely consequence for the snark population? Explain your answer.

(4 marks)

(d) Outgrabes are organisms similar to borogoves but they are not native to the island. Some outgrabes were introduced accidentally to the island, so the island's managers began to poison them. There were no noticeable effects on wildlife for several years. However, after this time jabberwocks on the island began to die. Explain what might be causing the deaths of the jabberwocks.

(4 marks)

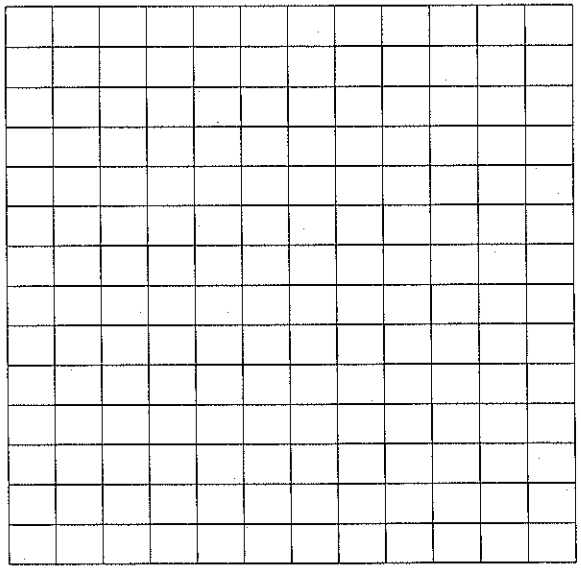
(e) An important niche is missing from this food web. Name the niche and explain its function in the island community.

(4 marks)

35. Nitrate and phosphate are two nutrients that plants take from the soil in dissolved form. An investigation was carried out to determine the effect of varying soil nitrate levels on plant growth. Several plants were grown in pots of standard commercial potting mix and each was watered with a particular concentration of nutrient solution. The results are summarised in the following table.

Concentration of Nutrient Solution (g/L)		Height of Plant At Maturity (cm)
Nitrate	Phosphate	
2	1	26
4	1	31
6	1	37
10	1	42
12	1	47
15	1	49
20	1	41

(a) From these data construct a graph showing the effect of nitrate concentration on height of plant at maturity. **(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.)**



(4 marks)

(b) (i) Describe in words the relationship between nitrate fertiliser concentration and height of plant at maturity, as shown by the graph.

(ii) From the graph, which rate of application of nitrate fertiliser produces the tallest plants at maturity?

(4 marks)

The study was then repeated using exactly the same procedure except that no phosphate was added to the nutrient solution. The results of this part of the investigation are shown in the table below.

Composition of Nutrient Solution (g/L)		Height of Plant At Maturity (cm)
Nitrate	Phosphate	
2	0	24
4	0	32
6	0	35
10	0	44
12	0	42
15	0	38
20	0	35

(c) (i) Plot these data on the same graph in (a) above.

(ii) Describe what these results indicate about optimum nitrate levels for plants.

(4 marks)

Question 35 (continued)

(d) (i) Name four variables that would have to be controlled for this investigation to be valid.

_____

_____

_____

_____

(ii) Name the following for this investigation.

Dependent variable(s) _____

Independent variables(s) _____

(4 marks)

(e) Name and describe two major features (other than controlled variables) that you would expect in the design of this investigation to improve the reliability of the results obtained.

(4 marks)

(i) _____

_____

_____

(ii) _____

_____

_____

SECTION C **(40 marks)** Suggested time: 50 minutes

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.)

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

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) Genetic information is stored in molecules of DNA. Using labelled diagrams describe the structure of DNA at the level of major components and describe how it carries genetic information.

36(b) Describe the processes by which marine and freshwater fish maintain water balance.

36(c) Tiger snakes can be found on many offshore islands around Australia. Most of these island populations are distinctive subspecies with unique characteristics of colour, pattern and size. Describe how these island populations could have evolved from a common mainland ancestor.

36(d) Ecosystems around the world are under threat from growth in human populations and many species are in danger of extinction. Present a rationale for conserving natural ecosystems and give brief examples of how biological knowledge can be applied in effective conservation.

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

37(a) A recent mission to Europa, a satellite of the planet Jupiter, has found liquid water. Using a specially designed probe, the spacecraft has collected samples of the water and of the sediment. Some of the samples are sent to your laboratory to test if they hold life.

Describe procedures you would use to determine if living organisms are present in the samples and, if so, if they are autotrophic or heterotrophic.

37(b) Similarities between plant and animal cells confirm that the cell is the basic unit of life, yet plant and animal cells differ considerably in structure.

Which aspects of cell structure are most similar between plant and animal cells?

Explain how the differences between animal and plant cells are related to their way of life.

37(c) Transpiration can be considered as a necessary evil for plants.

Discuss why transpiration can be seen as an advantage and a disadvantage for plants.

37(d) The cloning of humans by asexual methods is likely to become a reality in the next decade and may have already been achieved. This process produces exact genetic copies of an existing human. For instance, a great athlete could be cloned in an attempt to ensure future Olympic successes.

(i) Give biological reasons why a clone of a great athlete may not achieve the planned level of Olympic success.

(ii) A species that reproduces entirely by asexual cloning would have evolutionary disadvantages. Explain.

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.