

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.

- Some students were asked to write notes on what they observed happening in their classroom aquarium. Examples of their notes are shown below. Which is the best example of a scientific observation?
 - The brown fishes were always resting on the bottom in shallow holes that they probably made for themselves.
 - The big, lonely blue fish hardly moved at all and it didn't seem very happy.
 - The small yellow fishes always swam as a group and none of them was seen swimming on its own.
 - The striped fishes were always chasing the others, just to be mean or to try and eat them.
- Which of the following ecological concepts includes both biotic and abiotic components?
 - food web
 - ecosystem
 - population
 - biomass pyramid
- In some years, certain weather conditions occurring off the coast of Peru in South America cause a reduction in the circulation of the water in the ocean. As a result, the mineral nutrient content of the water falls to very low levels. Which of the following consequences is most likely?
 - More sunlight penetration means producers will increase in biomass and cause an increase in consumers.
 - The water will be less polluted and all populations will increase.
 - Producers will decline in biomass, causing a decline in consumers.
 - The reduced concentrations of dissolved ions will upset the osmotic balance of marine organisms.

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4. Which of the following statements about cell division is most correct?

- (a) Mitosis occurs during asexual reproduction.
- (b) Meiosis begins immediately after fertilization.
- (c) Mitosis explains why three brothers do not look alike.
- (d) Meiosis involves mutation of chromosomes.

5. Some people have a muscle in their forearms called the long palmar muscle, whereas others do not. It is inherited by a single gene. Charles has a long palmar muscle but his parents do not. Charles' brother, Fred, does not have a long palmar muscle. Fred's wife Louise has a long palmar muscle and so do their two daughters. What is the mode of inheritance of the long palmar muscle?

- (a) recessive sex-linked on the X chromosome
- (b) recessive autosomal
- (c) dominant autosomal
- (d) dominant sex-linked on the X chromosome

6. Which of the following statements regarding marine and freshwater fish is true?

- (a) Freshwater fish produce small quantities of concentrated urine.
- (b) Marine fish produce large quantities of dilute urine.
- (c) Marine fish have osmotic water gain through the gills.
- (d) Freshwater fish take up salt ions through the gills.

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7. A farmer observes that the volume of milk produced by each cow in a herd is different. To identify the reasons for this variation the farmer decides to record the observations for a period of time. A summary of the average results is shown in the table below.

Breed of cow	Diet	Average milk production (L/day/cow)
A	Grain fed	38
A	Grass fed	32
B	Grain fed	31
B	Grass fed	26

Which of the following conclusions regarding these observations is most likely to be correct?

- (a) The volume of milk produced is influenced by genes and environment.
- (b) The volume of milk produced is influenced by genes alone.
- (c) The volume of milk produced is influenced by environment alone.
- (d) The volume of milk produced is influenced by many random factors.

8. An endotherm moves from a cool place to a hotter one. Which of the following changes is most likely to occur?

- (a) Skin muscles will contract to hold hairs erect.
- (b) Blood vessels near the body surface will dilate (expand).
- (c) Urine production will increase.
- (d) Body temperature will fall, to compensate.

9. An enterprising farmer plans to start a new business raising crocodiles for leather. The plan is to feed chickens to the crocodiles. When a crocodile is killed for its skin, the body will be dried and crushed to produce chicken feed. The farmer believes that this will be a self-sustaining system where no money is spent on food for either the crocodiles or the chickens. Which of the following statements about the plan is most correct?

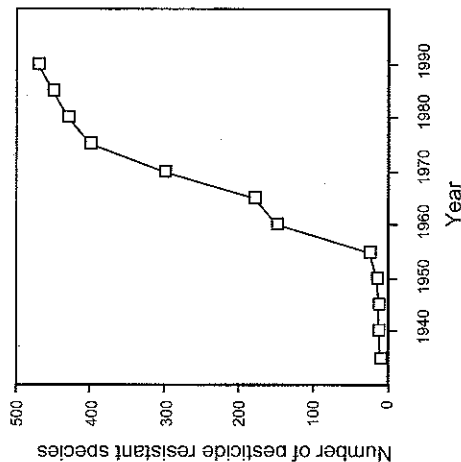
- (a) The plan will succeed because there is complete recycling.
- (b) The plan will succeed because both crocodiles and chickens will have high protein diets.
- (c) The plan will fail because energy conversion in feeding relationships is not 100% efficient.
- (d) The plan will fail because both the crocodiles and chickens are consumers.

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Questions 10–12 relate to the following information.

Pesticides were introduced into agriculture in the 1940s to control pest species and boost production. However, since then many pest species have evolved resistance to specific pesticides. The known number of pest species showing resistance to one pesticide, DDT, over the years 1935 to 1990, is shown below.

The number of species resistant to DDT



10. Which of the following statements about pesticide resistance can be concluded correctly from the graph?

- (a) The rate of increase in the number of resistant species declined after 1975.
- (b) Each pest species was gradually becoming more resistant.
- (c) Individual pests were becoming more resistant during their lives.
- (d) Use of DDT increased sharply after 1955.

11. Which of the following is a fault in the graph as presented?

- (a) Years should be on the vertical axis and resistant species on the horizontal axis.
- (b) There are no units indicated on the vertical axis.
- (c) There is no legend or key.
- (d) The title does not mention both the dependent and independent variables.

12. Which of the following explanations for the development of pesticide resistance is most likely?

- (a) The pesticide causes mutations in pest species.
- (b) After pesticide spraying, some resistant pest organisms survive and reproduce.
- (c) Individual pest organisms develop resistance after repeated exposure to pesticides.
- (d) Pesticides decay very rapidly in the environment.

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13. The greenhouse effect refers to an increase in global temperature caused by rising carbon dioxide concentrations in the earth's atmosphere. Which one of the following points is most likely to result from the greenhouse effect?

- (a) an increase in species extinctions
- (b) an increase in biomagnification in food webs
- (c) a fall in oxygen for respiration
- (d) a fall in photosynthesis rates

14. Which of the following statements about the amount of nutrients in the biosphere is true?

- (a) The amount of nutrients in the biosphere is increasing.
- (b) The amount of nutrients in the biosphere is decreasing.
- (c) The amount of nutrients in the biosphere fluctuates.
- (d) The amount of nutrients in the biosphere stays constant.

15. The following table summarises data measured for some soft-bodied aquatic animals collected from a pond.

Animal	Length (cm)	Body weight (g)	Surface area (cm ²)
A	4	4	12.2
B	2	0.5	0.8
C	1.5	0.4	0.4
D	2	1.5	10.5

Which of these animals has the greatest ratio of surface area to body weight?

- (a) animal A
- (b) animal B
- (c) animal C
- (d) animal D

16. In modern times fewer animals are used for scientific experiments and science education than in the past. Which of the following is the best explanation of why this change has come about?

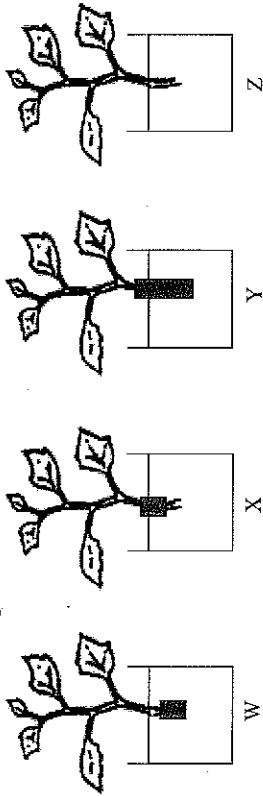
- (a) It is now against the law to perform any animal experiments.
- (b) Society and the scientific community expect that these experiments will only be performed when absolutely necessary.
- (c) Modern scientists are less cruel than those in the past.
- (d) There is less need for these experiments because we already know nearly all we need to know about animals.

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Questions 17–19 refer to the following information.

Four young cuttings were taken from a single plant and placed in water. Each cutting was painted with a waterproof latex coating as shown in the diagrams below, except for one that was left alone. The cuttings were observed and time of wilting noted.

■ Latex coating



- W latex covering the base and a small part of the stem of the cutting
 X latex covering the stem except for the cut base
 Y latex covering the stem and the cut base
 Z no latex covering

17. Which two cuttings would best test the hypothesis that the cuttings take in water through the cut end?

- (a) cuttings W and X
 (b) cuttings Y and Z
 (c) cuttings X and Y
 (d) cuttings X and Z

18. The cuttings wilted in the order Y, W, X and Z from first to last. For W to survive longer than Y it must have had a water supply. What would be the most likely process by which it gained water?

- (a) osmosis via the stem epidermis
 (b) active uptake of water by the stem epidermis
 (c) xylem vessels in the surface of the stem
 (d) phloem vessels in the surface of the stem

19. One of the following options would **not** improve the design of this investigation significantly. Which one is it?

- (a) repeat the investigation in a range of plant species
 (b) repeat the investigation on another day
 (c) use a larger number of cuttings for each container
 (d) draw a graph of the results

20. What is the chief function of root hairs?

- (a) provide a direct passage from the soil to the xylem
 (b) insulate the root in cold conditions
 (c) increase the surface area for absorbing water and nutrients
 (d) minimise damage to the main roots if the plant is transplanted

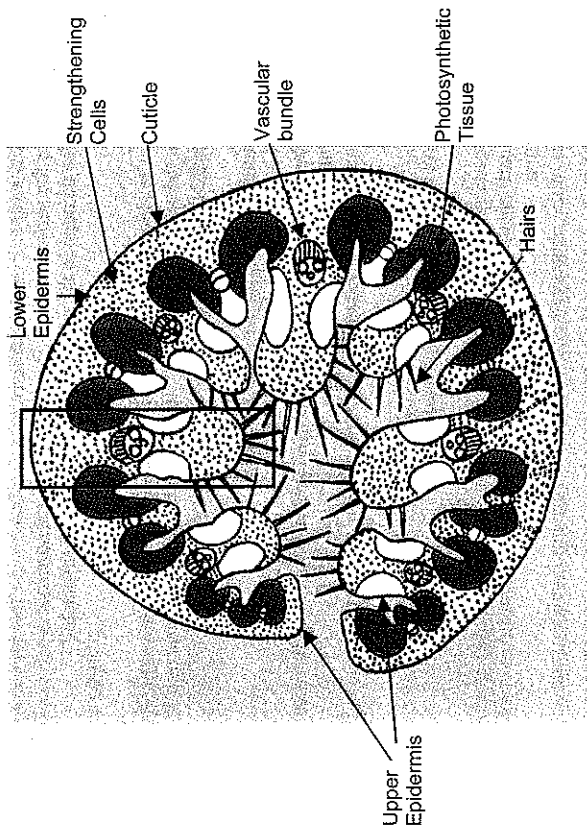
21. A suspension of red blood cells is placed in a clear solution at room temperature. Under the microscope the solution immediately turns red and all cellular structure seems to disappear. Which of the following statements is most correct?

- (a) The solution was distilled/deionised water.
 (b) The solution was saturated with sea salt.
 (c) The solution contained no red pigment, so the red pigment diffused across the membrane of the red blood cells.
 (d) The solution was of a similar concentration to that of the red blood cells.

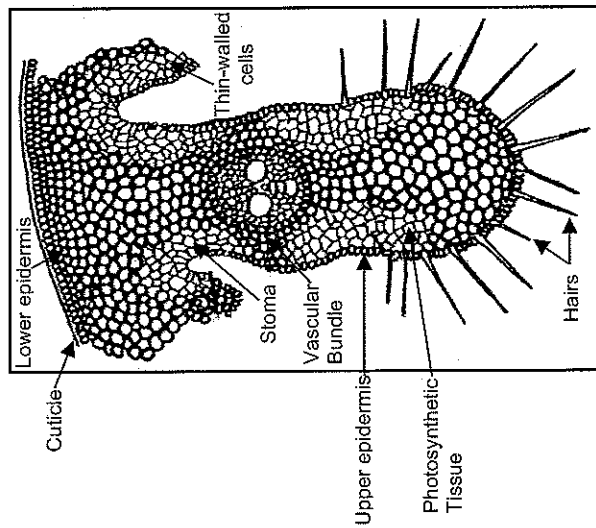
22. Which statement about photosynthesis is correct?

- (a) The rates of photosynthesis and respiration are equal at all times in plants.
 (b) The overall chemical change in photosynthesis is the opposite of aerobic respiration.
 (c) The part of the photosynthesis reaction that does not involve oxygen occurs in the cytoplasm.
 (d) Photosynthesis occurs in the mitochondria.

23. The two diagrams below show sections through the leaf of a marram plant (*Amphiphila* spp).



Transverse section of marram leaf (x20)



Enlarged section of marram leaf shown in the box above (x100)

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What is the most likely environment for this plant?

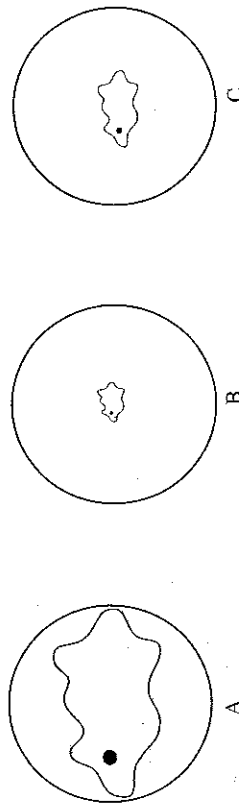
- (a) a swampy environment
- (b) a tropical rainforest environment
- (c) an arid environment
- (d) a moist woodland environment

24. Which pair of cell components has the least relationship in terms of function?

- (a) nucleus – ribosome
- (b) centrioles – mitochondria
- (c) endoplasmic reticulum – Golgi body
- (d) plasma membrane – cell wall

Questions 25 and 26 refer to the diagrams below of an organism viewed under a microscope at varied magnifications.

The magnification for A is 600x and the cell is known to be 150µm long.



25. What is the magnification of the microscope for diagram C?

- (a) 180x
- (b) 120x
- (c) 240x
- (d) 400x

26. What is the field of view (field diameter) of the microscope for diagram B?

- (a) 3.00 mm
- (b) 1.75 mm
- (c) 1.25 mm
- (d) 0.75 mm

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27. Which of the following statements about enzymes is most correct?

- (a) Enzymes are usually specific for a particular substrate.
- (b) Enzymes are used up in the chemical reactions they catalyse.
- (c) Enzymes usually catalyse many different chemical reactions.
- (d) Enzymes decrease and increase the rates of chemical reactions.

28. Food digestion in mammals is a complex process. As food passes through the digestive tract, it is exposed to different digestive processes. The table below shows the major enzymes involved in the digestion of carbohydrates and proteins and the conditions within several sections of the digestive tract.

Enzymes secreted in various sections of the digestive tract.

Section of the digestive tract	Enzyme/s active in carbohydrate digestion	Enzyme/s active in protein digestion	Temperature (°C)	pH
1. Mouth	Salivary amylase	None	variable	7
2. Stomach	None	Pepsin	37	2
3. Small intestine	Pancreatic amylases	Trypsin, chymotrypsin and others	37	7

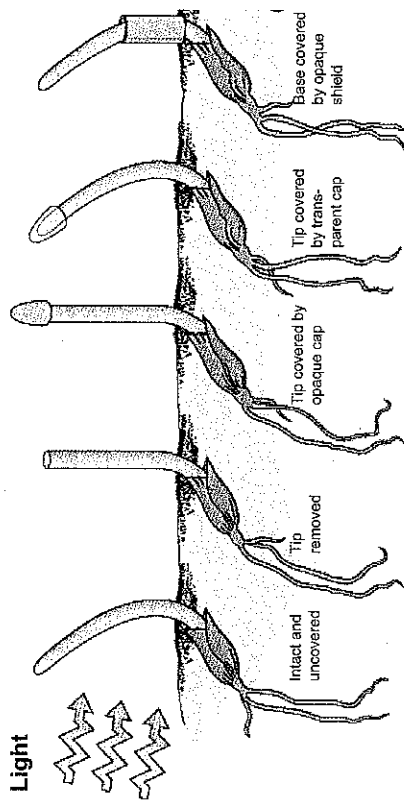
Using information from the table, select the MOST correct explanation of why each enzyme does not continue to work once it moves on to the next section of the digestive tract.

- (a) There are no carbohydrates in the stomach.
- (b) Changes in pH affect enzyme function.
- (c) Carbohydrate and protein digestion cannot occur in the same section of the digestive tract.
- (d) Temperature changes between sections of the digestive tract stop enzymes from functioning.

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Questions 29 and 30 relate to the following information.

In 1880, Charles and Francis Darwin performed some of the earliest investigations on photoperiodism, the response of plants to light. They suggested that the tip of plant seedlings was responsible for causing plants to bend towards the light. The Darwins reasoned that if their suggestion was correct, then seedlings with the tips removed or covered would not respond to light. They set up an experiment as shown below.



29. What was the control in this experiment?
- (a) The seedling with an opaque shield around the base.
 - (b) The type of cap placed on some seedlings.
 - (c) The removal of the seedling tip.
 - (d) The seedling left intact and uncovered.
30. What is the best conclusion from this experiment?
- (a) Seedlings cannot detect light in the presence of a cap.
 - (b) Light is essential for seedling growth.
 - (c) A hormone from the tip of a seedling causes it to respond to light.
 - (d) The tip of a seedling controls its response to light.

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SECTION B (100 marks)

(Suggested time: 90 minutes)

Attempt all questions in this section. Each question is worth 20 marks. Write answers in the spaces provided. Use black or blue ink or ball point pen.

31. *Giardia lamblia* is a single-celled, eukaryotic organism living in the gut of endothermic hosts. This organism is unusual because it lacks several cell components present in most other eukaryotic cells.

Cellular components	Present in many eukaryotic cells	Present in <i>Giardia</i>
Nucleus	Yes	Yes
Vacuole	Yes	Yes
Ribosomes	Yes	Yes
Mitochondria	Yes	No
Endoplasmic reticulum	Yes	No
Golgi bodies	Yes	No
Centrioles	Yes	Yes
Cilia	Yes	No

- (a) Name and describe the function of four (4) cell components present in *Giardia*.

(4 marks)

- (b) Name and describe the function of four (4) cell components that are missing from *Giardia*.

(4 marks)

- (c) (i) Name the type of respiration used by *Giardia*.

- (ii) Write the word equation for this type of respiration.

- (iii) What does this indicate about the natural environment of *Giardia*?

(4 marks)

- (d) For each of the substances listed below, state why it is important to the functioning of *Giardia* and give a brief reason for your answer.

- (i) ATP

- (ii) Protein

(4 marks)

- (e) It is highly unusual for eukaryotic cells to lack the organelles missing from *Giardia*. This raises questions about *Giardia*'s evolutionary origin.

(i) If genes for the missing organelles are found in the DNA of *Giardia lamblia*, what does this indicate about these organelles in *Giardia*'s evolutionary history?

(ii) If genes for the missing organelles are **NOT** found in the DNA of *Giardia lamblia*, what does this indicate about these organelles in *Giardia*'s evolutionary history?

(4 marks)

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32. Organisms are able to maintain their internal conditions within a narrow range even though they live in environments which may change. Such internal control requires energy and involves many physiological systems and patterns of behaviour.

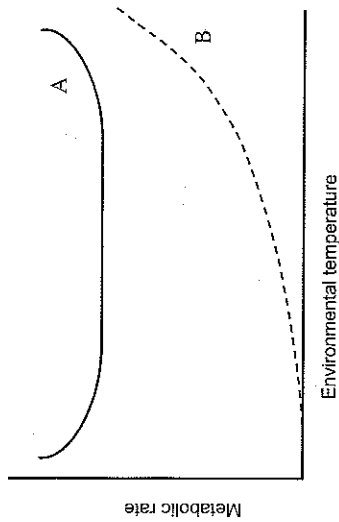
(a) (i) List one (1) way by which animals obtain energy from their environment.

(ii) List three (3) ways by which animals use or lose energy.

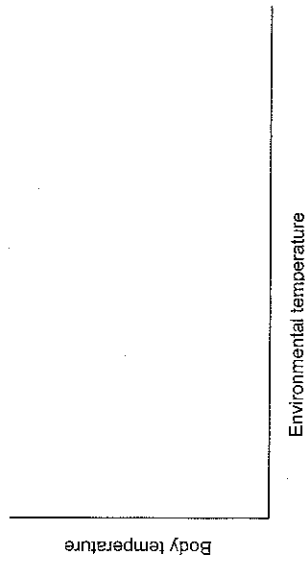
(4 marks)

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- (b) The following graph shows the relationship between environmental temperature and metabolic rate for two organisms, A and B.



- (i) On the graph below, sketch the relationship between environmental temperature and body temperature for organism A and for organism B. Ensure that you label each line.



- (ii) Give an example of an animal which is ectothermic.

Give an example of an animal which is endothermic.

(4 marks)

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- (c) Briefly state two (2) advantages and two (2) disadvantages of ectothermy.

Advantages

1. _____
2. _____

Disadvantages

1. _____
2. _____

(4 marks)

- (d) Endothermic animals maintain heat balance using a negative feedback system. Identify and briefly explain the function of any two (2) essential components of a negative feedback system.

(4 marks)

- (e) Briefly state four (4) special adaptations of endothermic animals to living in extremely hot environments.

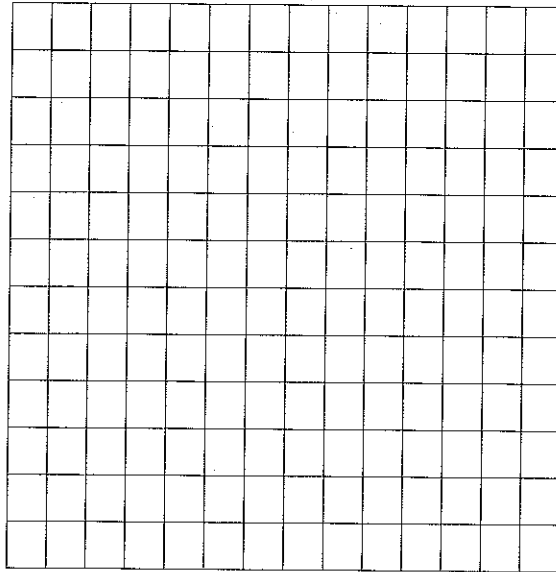
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33. While collecting aquatic animals in a stream, biology students observed fish that were eating insects living amongst the rocks on the stream bed. They hypothesised that predation by the fish was decreasing the population of the insects. To test this hypothesis, the students placed 10 wire mesh cages covering 1m² of the stream bed. The mesh on the cages allowed the insects to enter and leave, but excluded fish from the inside of the cage. They also placed 10 wire frames of equal dimensions to the wire mesh cages but without any mesh. These frames allowed both fish and insects to enter and leave without restriction. Each week for six weeks the students counted the number of insects in each of the cages and in each of the wire frames. They calculated the average number of insects in cages and the average number of insects in frames. The results are shown below.

Time in weeks	Average number of insects collected/m ²	
	Cages (fish excluded)	Frames (fish can enter)
1	65	70
2	70	75
3	Data lost	65
4	90	75
5	110	70

- (a) On the grid provided, draw a line graph of these data for both the cages and the wire frames. (If you wish to have a second attempt at this item, the grid is repeated on page 35. If you do use the repeat grid, you must clearly cancel your working on the grid on this page and clearly indicate that the answer to be marked is on page 35).



(4 marks)

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The students were asked to estimate the number of insects in the wire frames in Week 6 and the number of insects in cages in Week 3.

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

(4 marks)

- (c) The students' original hypothesis was that predation by the fish decreased the numbers of insects on the stream bed. Do the experimental results support the hypothesis? Explain your answer by referring to the data collected and to the design of the experiment.

(4 marks)

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- (d) (i) What is the control for this experiment?

- (ii) Why is the control needed?

- (ii) Explain why the students did not use just one cage and just one wire frame.

(4 marks)

- (e) For the experiment described, name the

- (i) dependent variable.

- (ii) independent variable.

(2 marks)

- (f) A student complained that the experiment was flawed because there was at least one uncontrolled variable. Name one uncontrolled variable and say why it is important.

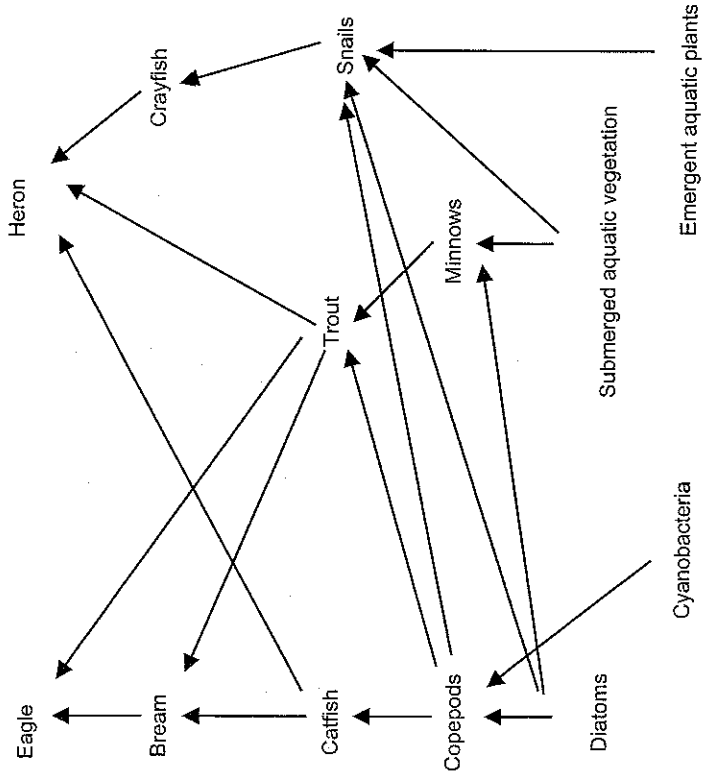
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34. The following diagram shows a simplified food web occurring in a freshwater lake community in southern Australia.



(a) If a food pyramid was drawn for this community, which four (4) organisms would occur at its base?

(4 marks)

(b) As mentioned on the previous page, this food web has been simplified. Describe briefly two (2) ways in which this could have been done.

(4 marks)

(c) PCBs are synthetic toxic chemicals that accumulate in the bodies of organisms. A study of the organisms in the lake community determined the concentrations of PCBs, measured in parts per million (ppm), in the bodies of herons, minnows, trout and diatoms. The concentrations are listed below.

(i) Next to each concentration, write the name of the organism most likely to have that level of PCBs in its body.

6 ppm	_____
25 ppm	_____
60 ppm	_____
250 ppm	_____

(ii) Briefly explain your answer to part (i).

(4 marks)

- (d) Indicate whether each of the following statements about the food web is true or false. Give a reason for your answer.

- (i) Solar energy recycles through the food web.

- (ii) Some of the biomass in the bream will eventually be returned to the emergent aquatic plants.

(4 marks)

- (e) Energy transfer between levels in a food pyramid is not 100% efficient.

- (i) Why is the transfer of energy between trophic levels less than 100% efficient?

- (ii) It is uncommon to find an animal which feeds exclusively as a fourth or higher order consumer. Why is this the case?

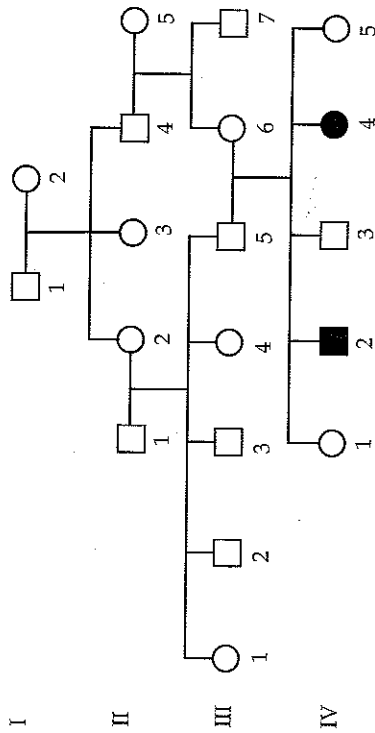
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35. The pedigree below shows the pattern of inheritance of a recessive autosomal condition in guinea pigs. Individuals II 1, II 5 and III 7 are known to be homozygous dominant.



- (a) Using the symbols 'A' for the dominant allele and 'a' for the recessive allele, indicate the possible genotype(s) of the following individuals.

12

Π3

III 5

IV2

(4 marks)

- (b) Explain, showing your working and using evidence from the pedigree, why the condition is not sex-linked.

[illegible]

- (c) A breeder plans to cross I 1 and III 6. What is the probability that their first offspring will show the condition? Show your working.

(4 marks)

- (d) The breeder wishes to know whether individual IV 5 is homozygous or heterozygous. How could this be determined? Show your working.

(4 marks)

- (e) Breeders have been trying unsuccessfully for many years to eliminate this condition from captive guinea pig populations. Explain why they are unlikely to be successful.

(4 marks)

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.)

SECTION C consists of two questions, 36 and 37. There are four parts to each question. You must answer **two** parts from Question 36 and **two** parts from Question 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 indicate the structure of DNA and describe its functions in the cell cycle.

36(b) Relate the different toxicity, solubility and need for rapid removal of different nitrogenous wastes from different vertebrate groups to the amount of water available from the environment.

36(c) Use diagrams of meiosis to explain the chromosomal basis of the determination of sex in mammals.

36(d) In what ways are urban and agricultural ecosystems similar in their inputs, outputs, amount of recycling of matter and stability? In what ways do they differ? What problems might arise if human population growth is concentrated in urban ecosystems?

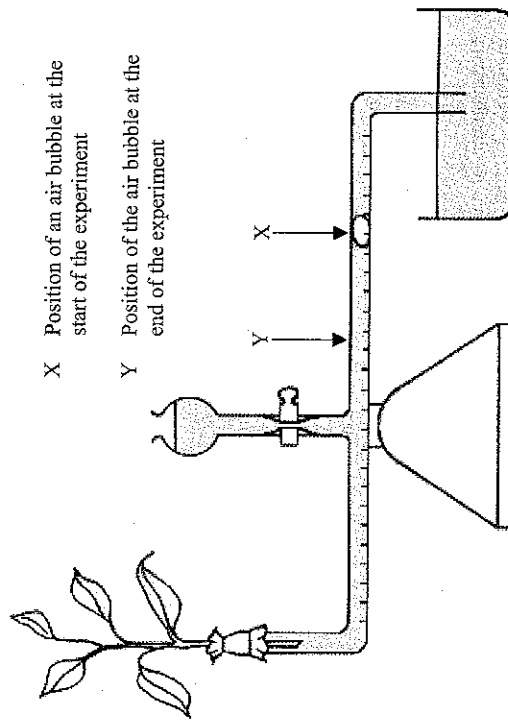
Answer any two questions from 37(a) to 37(d). (10 marks for each)

37(a) One special feature of the marine invertebrates called sea stars is that the concentration of salt in their bodies is identical to that in seawater.

- Describe, using labelled diagrams, what would happen to a sea star cell placed in (a) seawater, (b) a saturated (highly concentrated) salt solution and (c) distilled (pure) water.
- Explain the process involved in the diagrams you drew in part (i) with reference to semi-permeable membranes, solutes and solvents.

37(b) Examine the apparatus drawn below.

- What is its purpose and how does it work?
- Name four (4) physical, environmental factors (other than plant structures) that would influence the independent variable being measured. Explain the effect of each factor.



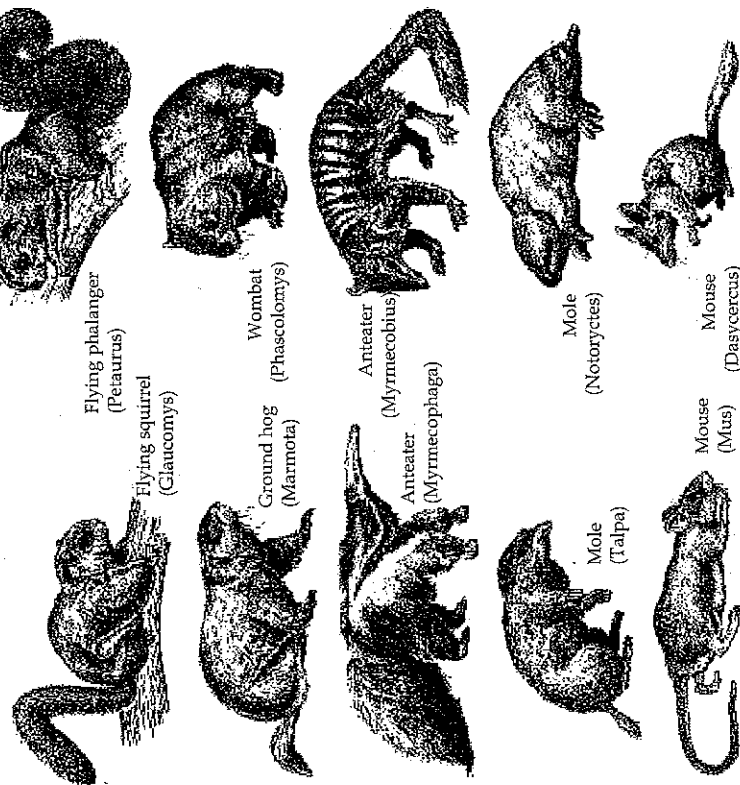
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37(c) Many of Australia's native mammals are marsupials. Their young are born at a very young age and are carried by the mother in a pouch. Most mammals in the northern hemisphere belong to a different evolutionary line called placental mammals, in which the young develop to a more advanced stage, nourished through a placenta, within the mother's body before birth. Despite these major differences, many Australian marsupials have a very similar body structure to northern hemisphere placental mammals.

- Outline the fundamental evolutionary processes which affect all organisms.
- By specific reference to any pair of animals shown below, explain how animals from different groups could have evolved to look so similar.

Placentals

Marsupials



SEE NEXT PAGE

37(d) "The cane toad (*Bufo marinus*) was introduced into Australia in 1935 to control the sugar cane beetle, but it proved ineffective. For the past 60 years, cane toads have been expanding their territory in Australia, and are capable of colonising at least four of the mainland Australian states, [including Western Australia]. As the toad's geographical range continues to expand, concern has increased about their detrimental environmental effects, particularly on the wetlands of the Northern Territory. Studies into the feasibility of biological control have commenced."

- (i) What steps should have been taken before the cane toad was first introduced in 1935 to prevent it from becoming a pest?
- (ii) Discuss, using examples of successful and unsuccessful biological controls, the kinds of biological controls that might be used to control the cane toad in the future.

Use the grid below to answer question 35(a) if you have cancelled your first attempt.

[illegible]

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).