



TERTIARY ENTRANCE EXAMINATION, 1999

QUESTION/ANSWER BOOKLET

**BIOLOGY**

Please place your student identification label in this box

STUDENT NUMBER -

In figures

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In words

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**TIME ALLOWED FOR THIS PAPER**

Reading time before commencing work: Ten minutes

Working time for paper: Three hours

**MATERIAL REQUIRED/RECOMMENDED FOR THIS PAPER**

**TO BE PROVIDED BY THE SUPERVISOR**

This Question/Answer Booklet

Separate Multiple Choice Answer Sheet

Standard Answer Book

Paper Binder

**TO BE PROVIDED BY THE CANDIDATE**

*Standard Items:* Pens, pencils, eraser or correction fluid, ruler

*Special Items:* A 2B, B or HB pencil for the separate Multiple Choice Answer Sheet and calculators satisfying the conditions set by the Curriculum Council.

**IMPORTANT NOTE TO CANDIDATES**

No other items may be taken into the examination room.

It is your responsibility to ensure that you do not have any unauthorised notes or other items of a non-personal nature in the examination room. If you have any unauthorised material with you, hand it to the supervisor BEFORE reading any further.

STRUCTURE OF THE PAPER

Section	Questions	Students should attempt	Marks	Suggested time/minutes
A Multiple choice	1-30	ALL	60 (30%)	40
B Short answers	31-35	ALL	100 (50%)	90
C Extended answers	36*	Two parts	40 (20%)	50
	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

Section A Write your answers on the separate Multiple Choice Answer Sheet using a 2B, B or HB pencil. Do not use a ball point or ink pen. Marks are not deducted for wrong answers.

Section B Write your answers in the spaces provided in this Question/Answer Booklet. Use a blue or black pen (not pencil) for this section.

Section C Write your answers in the Standard Answer Book. 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

Make sure that your Student Number is on your Question/Answer Booklet and Standard Answer Book(s).

Attach the Question/Answer Booklet to the FRONT of the Standard Answer Book(s) with the paper binder provided.

SEE NEXT PAGE

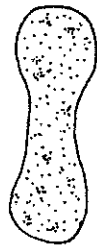
SECTION A (60 marks)

Suggested time: 40 minutes

Record an answer for Questions 1-30 by marking your choice of alternatives on the separate Multiple Choice Answer Sheet using a 2B, B or HB pencil.

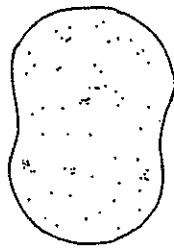
If you want to change an answer, rub out your first answer and mark the new choice. The answer sheet for Section A will be collected separately by the Supervisor.

Questions 1, 2, 3 and 4 refer to the following diagram showing a transverse section of a cell in its normal state (A) within an organism and the same cell after it has been placed in distilled water (B) for a few seconds.



A

Normal state



B

In distilled water

1. Which of the following is a true statement regarding this cell?

- (a) This cell is a plant cell because it has a central vacuole.
- (b) This cell is an animal cell because it is able to absorb water.
- (c) This cell is a plant cell because it is able to absorb water.
- (d) This cell is an animal cell because it lacks a cell wall.

2. Which of the following statements best explains the change in the cell's shape after it was placed in the distilled water?

- (a) Active transport of water into the cell exceeded the rate at which sodium and chloride ions diffused out of the cell.
- (b) There was a net movement of water into the cell because the concentration of sodium and chloride ions was greater inside the cell than outside the cell.
- (c) Sodium and chloride ions were actively transported into the cell, and water followed by passive diffusion.
- (d) Sodium and chloride ions were unable to diffuse out of the cell to balance the net inward diffusion of water.

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3. What is most likely to happen if the cell is allowed to remain in the distilled water?
- The cell would continue to expand until the plasma membrane burst, killing the cell.
  - The cell would remain in the shape shown in B above and would adapt to functioning in its new environment.
  - The cell would slowly regain its original shape (A) and adapt to functioning in its new environment.
  - The cell would take on a new function consistent with its new shape.

4. When examined under a microscope, this cell was found to lack a nucleus. Which of the following would be a consequence of the cell being without a nucleus?

- The cell is restricted to aerobic metabolism as an energy source.
- The cell is unable to retain its shape when placed in a dilute solution of sodium chloride.
- The cell is unable to manufacture new protein molecules as required.
- The cell has a greater life expectancy than those cells with a nucleus.

**Questions 5, 6 and 7 refer to the following information:**

Amylase is a digestive enzyme found in the saliva of vertebrate animals. It catalyses the following reaction:



Maltase is a digestive enzyme secreted into the small intestine of vertebrates. This enzyme catalyses the following reaction:



5. Which of the following statements concerning enzyme function is correct?
- Enzymes determine the nature of the products of any chemical reaction.
  - Enzymes are essential raw materials that are converted into some of the products of a chemical reaction.
  - Enzymes can act on a wide variety of substrates, but always give the same product.
  - Enzymes serve only to increase the rate of a reaction.

6. If we were to compare the active site of the enzyme amylase with the active site of the enzyme maltase, which of the following would we expect to find?
- They are similar because the product of amylase is maltose, which is the substrate of maltase.
  - They are different because the substrate starch is different from the substrate maltose.
  - They are similar because the active sites of all enzymes have a similar shape.
  - There is no reason to expect the two active sites to be either similar or different.

7. Salivary amylase is known to have only a limited role in the digestion of starch in most animals. Once the food is swallowed, the activity of the enzyme decreases. Which of the following provides the best explanation of this observation?

- The pH of the saliva is the optimal pH for amylase activity. When the food is swallowed, the stomach pH is too low for the enzyme to function.
- The temperature of the saliva is the optimal temperature for enzyme activity. When the food is swallowed, the stomach temperature is too high for the enzyme to function.
- When the food is swallowed the amylase is diluted by the stomach contents, stopping the enzyme from working.
- All enzymes are specific in their activity to one part of the body. They will become inactive when moved to another place.

**Questions 8, 9 and 10 refer to the following information:**

A student was studying the feeding preferences of the zebra finch (*Poephila guttata*), a popular cage bird. She placed weighed amounts of four types of seed in separate trays in a cage containing five of the birds. After 6 hours she reweighed the contents of the trays. Her findings are recorded below:

Seed Type	A	B	C	D
Weight of tray contents at start (g)	35	48	36	42
Weight of tray contents after 6 hours (g)	28	18	12	38

8. Which of the following variables would have the least effect on the validity of the experiment?

- The size of the cage used.
- The location of the trays in the cage.
- The freshness of each seed type.
- The size and shape of the seed trays used.

9. During the course of the investigation the student made the following notes. Which of these notes is **not** an observation based on this experiment?
- The tray of seed type D became wet because it was placed near the water dish.
  - All five birds fed from all four trays during the investigation.
  - Seed types B and C are the types the bird would eat in the wild.
  - A total of 65 g of seed was removed from the trays in the six-hour period.
10. In concluding that, of all the seeds tested, zebra finches prefer seed type B, which of the following assumptions must the student make?
- All zebra finches have identical food preferences.
  - Most seed missing from all the trays was eaten.
  - All five zebra finches ate equal amounts of food.
  - There was no other food source in the cage.
11. In Holstein Friesian cattle black coat colour is dominant to red coat colour and is considered a desirable feature of the breed. The alleles for coat colour are autosomal. For a particular bull to have breeding value it must be homozygous for black coat colour. Which of the following procedures would be the best way to determine whether a bull is homozygous for black coat?
- Mate the bull with 10 red cows and check the colour of the offspring.
  - Mate the bull with 10 black cows known to be heterozygous for coat colour and check the colour of the offspring.
  - Mate the bull with 10 cows of random coat colour and check the colour of the offspring.
  - Mate the bull's mother and father again and check the colour of their offspring.
12. Which of the following forms of reproduction would show the greatest genetic variation in the offspring produced?
- A citrus tree that is fertilised by pollen from other flowers on the same tree.
  - Cross-fertilisation between two apple trees grown from cuttings from the same parent.
  - Cross-fertilisation between a pair of garden snails that are hermaphrodites (possess both male and female sex organs).
  - A solitary tapeworm that fertilises its own eggs.
13. Which of the following statements is in agreement with scientific methodology?
- If a hypothesis is properly constructed then tests and observations will support it.
  - If a hypothesis is properly constructed then it will lead to a testable prediction.
  - If observations are accurate, they will support a hypothesis.
  - If experiments are properly controlled, they will generate a testable hypothesis.

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14. Which of the following is a correct statement about a controlled experiment?
- It proceeds at a rate controlled by the experimenter.
  - It includes experimental and control groups which must be tested together.
  - It is controlled by repeating the experiment many times.
  - It includes two groups of subjects that receive identical treatments.
15. A crop scientist noted that, over a period of 10 years, a species of beetle that feeds on rice gradually became resistant to an insecticide. Which of the following best explains this observation?
- The insecticide caused mutations in beetles exposed to the biggest doses.
  - Some beetles learned to tolerate the insecticide and passed this tolerance on to their offspring.
  - The insecticide caused the beetles to produce more diverse offspring.
  - Beetles with a natural resistance to the insecticide produced the most offspring.
16. A student decided to establish a self-sustaining ecosystem by sealing some sterilised soil, water and air in a glass container. Which of the following combinations of organisms should he add to the container in order to maximise his chances of success?
- Bacteria, beetles and spiders.
  - Bacteria, ants and fungi.
  - Bacteria, grass and grasshoppers.
  - Bacteria, fungi and beetles.
17. If you wanted to determine whether succession has occurred in a certain area, which of the following activities would be most helpful?
- Determine the number of trophic levels represented in the area.
  - Carry out a transect study of the area.
  - Measure the area's primary productivity.
  - Look at old photographs of the area.
18. Both energy and chemical nutrients flow through ecosystems. Which of the following is the most important difference between these two flows?
- Energy is recycled but nutrients are not.
  - Nutrients are recycled but energy is not.
  - The supply of nutrients is limited but the supply of energy is not.
  - Organisms always need nutrients but don't always need energy.

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19. Researchers studying the distribution of the insecticide DDT in a natural community found the following DDT concentrations in four different organisms:

**Organism**                      **Concentration of DDT (parts per million)**

<i>Avena fatua</i>	0.04
<i>Acrida conica</i>	0.50
<i>Smithopsis crassicaudata</i>	2.00
<i>Elanus notatus</i>	25.0

One of these organisms is the black-shouldered kite, a large predatory bird. On the basis of this information, which of the four organisms is it most likely to be?

- Avena fatua*
- Acrida conica*
- Smithopsis crassicaudata*
- Elanus notatus*

20. Which of the following determines the amount of energy passing through an ecosystem?

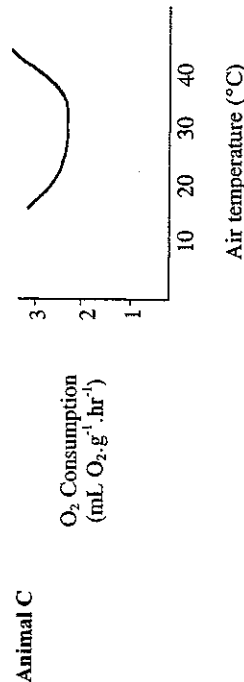
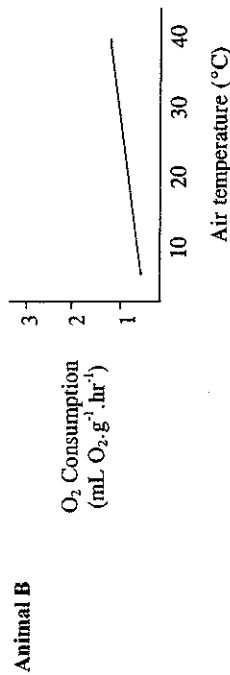
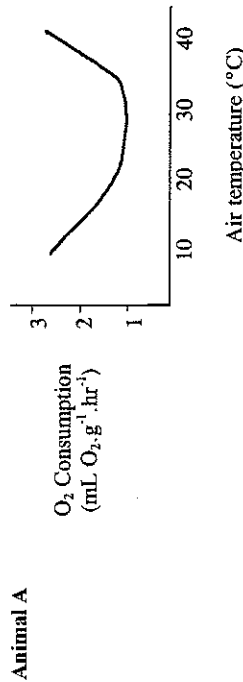
- The number of trophic levels.
- The amount of sunlight.
- The biomass of producers.
- The net primary productivity of the ecosystem.

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**Questions 21, 22 and 23 relate to the following information:**

A scientist interested in metabolism measured the mass specific resting oxygen consumption of three animals exposed to a range of environmental temperatures. The animals she studied were the red kangaroo, the dunnart (a mouse-sized marsupial) and a bobtailed skink (a medium-sized lizard).

Her results are presented in the graphs below:



21. Which of the following statements is true?

- Animal A is the skink because it has the lowest overall oxygen consumption.
- Animal A is the kangaroo because it shows evidence of endothermy and a low surface area : volume ratio.
- Animal A is the dunnart because it has the lowest overall energy consumption.
- Animal A is the dunnart because it shows evidence of both endothermy and a high surface area : volume ratio.

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22. At low environmental temperatures, the oxygen consumption of animal B is lower than that of animals A and C. Which of the following provides the best explanation for this observation?

- (a) Animal B is sleeping at those temperatures in order to conserve energy.
- (b) Animal B is a tropical species which is not adapted to low environmental temperatures.
- (c) The body temperature of animal B falls as environmental temperature falls.
- (d) Animal B is incapable of regulating its body temperature.

23. The scientist chose to measure oxygen consumption in **resting** animals. Which of the following is the best reason for choosing resting animals?

- (a) It increases the reliability of comparisons between species.
- (b) Oxygen consumption can be measured more accurately in resting animals.
- (c) The body temperatures of active animals may change.
- (d) It is impossible to measure oxygen consumption in active animals.

24. The desert hopping mouse, *Notomys alexis*, is capable of surviving indefinitely by eating a diet of dry seeds and without drinking any water. Which of the following statements would **not** help to explain this remarkable ability?

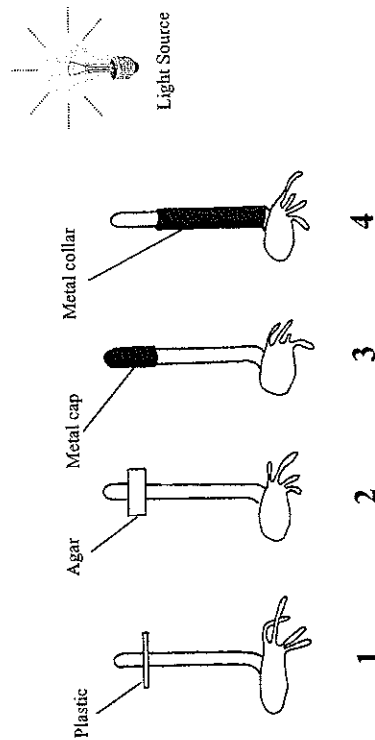
- (a) Seeds are rich in carbohydrates, which produce water when metabolised aerobically.
- (b) *Notomys* have kidneys which are capable of producing a highly concentrated urine.
- (c) Small body size helps to reduce evaporation rates at the surface of the animal.
- (d) These animals spend much of their time in cool, humid, underground burrows.

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### Questions 25 and 26 refer to the following information:

A coleoptile is a protective sheath covering the young shoot of plants in the grass family. Experiments on the coleoptiles of oat seedlings have yielded much information on the control of plant growth.

A student investigating growth in oat seedlings took four coleoptiles and subjected them to the treatments shown below. In treatments 1 and 2, the tip of the coleoptile was removed and then replaced, but remained separated from the rest of the shoot by a sheet of plastic (treatment 1) or a block of agar gel, a jelly-like material permeable to most substances (treatment 2). In treatment 3, the tip of the coleoptile was covered with a metal cap, and in treatment 4, the base of the coleoptile was surrounded by a metal collar.



25. Which plants would be expected to grow towards the light?

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

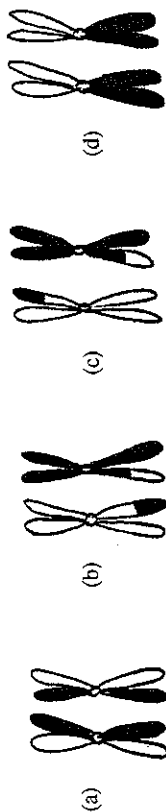
26. Which of the following statements would be a reasonable criticism of this investigation?

- (a) An untreated seedling should have been included.
- (b) More than one species of plant should have been used.
- (c) Natural light should have been used instead of artificial light.
- (d) The experiment should have been repeated with the light source on the left-hand side.

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27. The diagrams below show chromosomes present in a cell undergoing meiosis. The shaded portions represent maternal DNA and the unshaded portions represent paternal DNA.

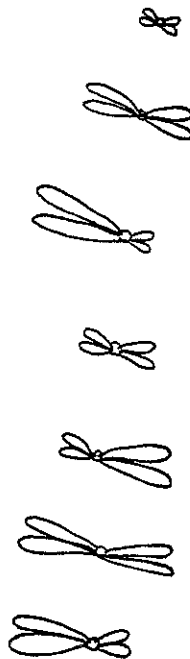
Which pair of chromosomes best shows the results of crossing over?



28. Which of the following best describes a gene?

- (a) A segment of DNA which codes for a particular protein.
- (b) An inherited characteristic of an organism.
- (c) A chromatid of a chromosome.
- (d) An enzyme responsible for a particular characteristic.

29. The diagram below shows all the chromosomes present in the nucleus of a single cell taken from the body of an insect.



Which of the following is a valid description of the cell from which these chromosomes were taken?

- (a) The cell is haploid but has one pair of homologous chromosomes.
- (b) The cell is haploid with no homologous chromosomes present.
- (c) The cell is diploid with seven pairs of chromosomes.
- (d) The cell is diploid with each chromosome containing one pair of chromatids.

30. The diagram below shows a food chain found in the jarrah forests of Western Australia:



In relation to the amount of nitrogenous waste produced per gram body mass, which of the following statements about the animals in the food chain is true?

- (a) The grasshopper will produce the greatest amount of nitrogenous waste.
- (b) The chuditch will produce the greatest amount of nitrogenous waste.
- (c) The dunnart and the chuditch will produce similar amounts of nitrogenous waste.
- (d) All three animals will produce similar amounts of nitrogenous waste.

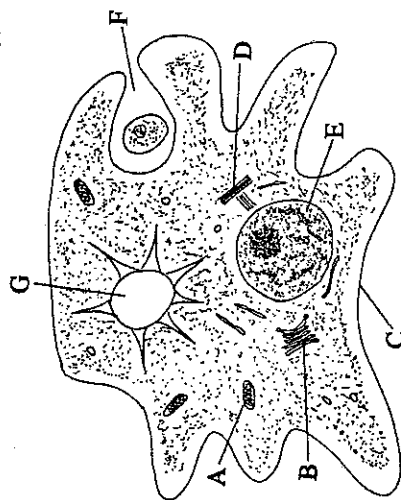
SECTION B (100 marks)

Suggested time: 90 minutes

Attempt all questions in this section. Write answers in the spaces provided. Use black or blue ink or ball point pen.

31. *Amoeba proteus* is a single-celled organism which is commonly found in freshwater ponds and streams. It is a slow-moving, large micro-organism which feeds mainly on other single-celled organisms.

The diagram below shows some of the internal structures found in a typical *Amoeba*:



- (a) Name the structures in the diagram which are labelled as follows:

- A \_\_\_\_\_  
 B \_\_\_\_\_  
 C \_\_\_\_\_  
 D \_\_\_\_\_  
 (4 marks)

- (b) You are observing this cell under the low power of a microscope. The diameter of the field of view is 1.5mm and you estimate that five cells would fit across the field of view.

- (i) What is the approximate width of an *Amoeba* cell in  $\mu\text{m}$ ?

- (ii) Estimate the diameter of structure E in  $\mu\text{m}$ .  
 \_\_\_\_\_  
 (2 marks)

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- (c) Name and describe the event occurring at F.  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 (4 marks)

- (d) A student placed an *Amoeba* cell in distilled water and noticed that, over a period of time, structure G slowly filled with a clear fluid and then suddenly contracted, expelling its contents from the cell. This was repeated for several hours. He then placed the *Amoeba* in a solution of sodium chloride, with the result that structure G suddenly contracted and did not expand again.

Suggest a reason for the behaviour of structure G in each environment.

In distilled water:  
 \_\_\_\_\_  
 \_\_\_\_\_

In sodium chloride solution:  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 (4 marks)

- (e) (i) Describe the function of structure A.  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 (2 marks)

- (ii) Name two structures not shown in the diagram and which you would expect to find in a single-celled plant.  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 (2 marks)

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332. The fox, *Vulpes vulpes*, a predator of small mammals, has been introduced into Australia. In an arid region of Western Australia, a group of researchers set out to study this species.

First, they chose two study sites known to be inhabited by foxes and monitored the total number of small mammals at each site for two years. They then enclosed Site 1 with a fox-proof fence and removed all foxes from that site. Site 2 was not fenced, nor was its fox population controlled in any way. The researchers continued to monitor the numbers of small mammals within each site for several years.

Their results are presented below:

**Small mammal density (individuals per hectare)**

Year	Site 1	Site 2
1	15	16
2	17	14
3*	14	13
4	37	14
6	24	13
8	27	13
10	28	14
12	32	18

\*Foxes were removed from Site 1 only in Year 3.

- (a) Use the grid below to plot the data for both sites. (4 marks)

(If you wish to have a second attempt at this item, the grid is repeated at the end of the examination book. Indicate clearly on this page if you have used the second grid).

A full-page view of a blank sheet of white graph paper. The grid consists of thin, black horizontal and vertical lines forming small squares. There are approximately 20 columns and 20 rows visible on the page.

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(b) Name of possible factors that could cause fluctuations in the number of small mammals per hectare, at either site, from year to year.

- (i) What was the main reason why the researchers monitored the small mammal density for two years before removing the foxes?
- (c)

- (ii) In this experiment, what is the independent variable? the dependent variable?

- (A) (i) Draw a valid conclusion from the data and your graph.

- (ii) State two assumptions you have made in drawing your conclusion.

- 1

- 2.

- (e) Describe two criticisms that could be made of this experimental design.

- (i)

- (iii)

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33. Research on a community in an arid environment near Shark Bay in Western Australia produced data on the diets of some of the common animals in the region. These data are presented below:

Animal	Diet
Dingo	Rabbit, native mice, dunnart, insects, plants, cats
Cat	Rabbit, native mice, dunnart
Rabbit	Plants
Native mice	Plants and insects
Dunnart	Insects
Insects	Plants

- (a) In the space below, draw a food web of this community, showing all feeding relationships among the organisms listed above.

(4 marks)

- (b) (i) An important group of organisms is missing from this food web.

Name this group: \_\_\_\_\_

What function does this group perform? \_\_\_\_\_

(2 marks)

- (ii) Suppose a biomass pyramid was constructed for the animal species in the food web. Which species would you expect to be at the top of the pyramid (in other words, to have the lowest biomass)? Explain your answer.

(2 marks)

- (c) (i) In the space below, draw a food chain containing five organisms from this community.

(2 marks)

- (ii) In general, food chains do not exceed five organisms. Explain why food chains are usually short.

(2 marks)

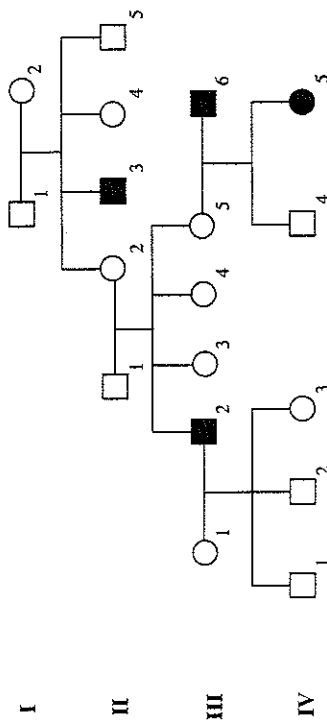
- (d) In the past there have been extensive dingo-shooting programs in Western Australia. Describe and explain the effect such a program would have on the Shark Bay community shown above.

(4 marks)

- (e) Rabbits are serious environmental pests. Rabbit calicivirus disease (RCD) is caused by a virus that is being introduced in many parts of Australia to control rabbit numbers. Infected rabbits die quickly and population numbers fall sharply. Even though there is no danger of RCD infecting other species, some biologists are concerned that the sudden removal of rabbits from an area may cause reductions in the size of populations of native animals. Explain how this could happen.

(4 marks)

34. Red-green colour deficiency in human vision (red-green colour-blindness) occurs in about 8% of males and 1% of females. The following pedigree shows its inheritance in one particular family:



KEY: ☐ Normal male    ☒ Male with red-green vision deficiency  
 Normal female     Female with red-green vision deficiency

- (a) The allele for this condition is sex-linked. Explain the term "sex-linked".

(4 marks)

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- (b) Use evidence from the pedigree to explain whether the allele is recessive or dominant.

(4 marks)

- (c) Use the letters B and b to show the genotypes of

- (i) individual I.2  
 (ii) individual II.2  
 (iii) individual III.6  
 (iv) individual IV.3

(4 marks)

- (d) For the marriage between individuals III.5 and III.6 calculate the genotype and phenotype ratios expected in their children. Show all working.

(4 marks)

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- (e) It is apparent from the pedigree shown that females can express sex-linked characteristics in their phenotype (see individual IV.5). Whilst this may be true for red-green colour-blindness, females rarely, if ever, suffer from more serious sex-linked diseases such as muscular dystrophy and haemophilia. Suggest why this is the case.

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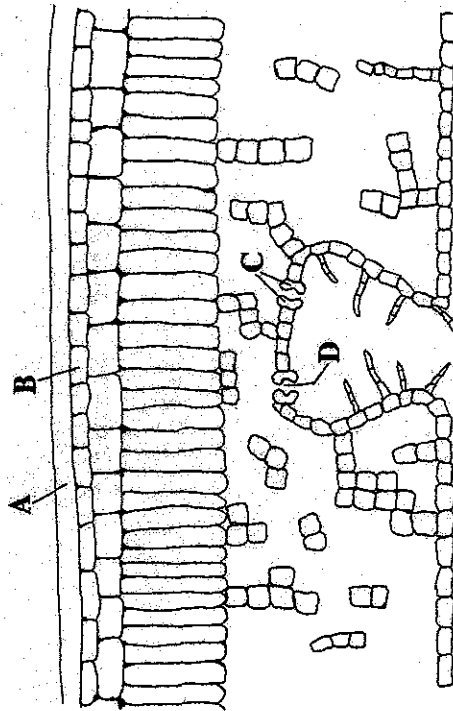
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(4 marks)

35. The figure below shows a cross-section through a leaf of *Nerium oleander*, a plant adapted to an arid environment.



- (a) Name the parts labelled

A \_\_\_\_\_

B \_\_\_\_\_

C \_\_\_\_\_

D \_\_\_\_\_

(4 marks)

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- (b) At a certain time of day, the two structures labelled C were observed to close the gap between them. Describe the mechanism that caused this to happen.

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(4 marks)

- (c) (i) List two features of this plant which suggest that it is well adapted to life in an area of low water availability.

1. \_\_\_\_\_

2. \_\_\_\_\_

(2 marks)

- (ii) Name two physiological processes that would be affected by the closure of the gap between structures C.

1. \_\_\_\_\_

2. \_\_\_\_\_

(2 marks)

- (d) Another species, the water lily, is a plant whose roots and stem are immersed in water and whose leaves float on the surface of ponds. Suggest two ways in which the leaves of water lilies would differ from the leaves of *Nerium oleander*.

(i) \_\_\_\_\_

(ii) \_\_\_\_\_

(4 marks)

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- (c) In the space below, draw a labelled diagram of the apparatus you would use to measure the rate of water loss from a shoot of the *Nerium oleander* plant.

(4 marks)

SECTION C (40 marks)

Suggested time: 50 minutes

ANSWER SECTION C IN THE 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 that 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;
- present information as a table;
- 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 36a to 36d. (10 marks for each)

- 36(a) A molecule of water from the soil is taken up by the root of a vascular plant and is eventually lost from a leaf by transpiration.

Describe the structures through which the water molecule moves in its journey, and the processes which cause it to be taken up by the plant and then to move through the plant.

- 36(b) Respiration is a process common to all living cells.

Describe in detail the nature and location of the chemical processes involved in aerobic respiration, and explain why these processes are essential for the maintenance of life.

- 36(c) Worldwide, most flowering plants have a feedback mechanism operating in their roots to limit the quantity of phosphate nutrient absorbed from the soil to the amount the plant needs. Most Australian native plants have evolved in soils that are very low in phosphate. As a result they do not possess this feedback mechanism and will quickly die from phosphate overload if treated with phosphate-rich fertilisers.

Describe the evolutionary process by which non-Australian plants have developed this protective mechanism to prevent phosphate overload.

- 36(d) In the wheat belt of Western Australia, large areas of natural vegetation have been cleared to create a modern agricultural ecosystem. Explain how the processes of energy flow and nutrient cycling would have occurred in the original ecosystem, and how they have been changed in the modern agricultural ecosystem.

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