

TERTIARY ENTRANCE EXAMINATION, 1988  
QUESTION/ANSWER BOOKLET

## BIOLOGY

Please place one of your student  
identification labels in this box

STUDENT NUMBER—in figures

In words

TIME ALLOWED FOR THIS PAPERReading time before commencing: Ten minutes  
Working time for paper: Three hoursMATERIAL REQUIRED/RECOMMENDED FOR THIS PAPER  
See page 2INSTRUCTIONS TO CANDIDATES  
See page 2

FOR MARKERS' USE ONLY							
SECTION	QU. NO.	1ST MARKER	2ND MARKER	SECTION	QU. NO.	1ST MARKER	2ND MARKER
B	31			C	39a		
	32				39b		
	33				39c		
	34				40a		
	35				40b		
	36				40c		
	37						
SUB TOTAL B				SUB TOTAL C			

TOTAL	1ST MARKER -	2ND MARKER -	FINAL TOTAL -

SEE PAGE 2

**MATERIAL REQUIRED/RECOMMENDED FOR THIS PAPER****TO BE PROVIDED BY THE SUPERVISOR**

This Question/Answer Booklet comprising 48 pages and 40 questions  
Separate Multiple Choice Answer Sheet

**TO BE PROVIDED BY THE CANDIDATE****Standard Items**

Pens, pencils, eraser, ruler

**Special Items**

A '2B' pencil for the Separate Multiple Choice Answer Sheet

**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. Please check carefully and if you have any unauthorised material with you hand it to the supervisor **BEFORE** reading any further.

**INSTRUCTIONS TO CANDIDATES**

Write your number on the front of this QUESTION/ANSWER BOOKLET.

Marks will be allocated as follows:

SECTION A—30 marks

SECTION B—46 marks

SECTION C—24 marks

**SECTION A:** Attempt all questions in Section A, using the Separate Multiple Choice Answer Sheet, which will be collected separately by the Supervisor.

Use a '2B' PENCIL. Do NOT use a ball point or ink pen.

Marks are not deducted for wrong answers.

**SECTIONS B AND C:** Write your answers in the places provided in the QUESTION/ANSWER BOOKLET.

Draw graphs in pencil before inking in the lines.

Use a blue or black **PEN** (not pencil) when answering Sections B and C.

Do NOT copy the question when writing an essay (Section C). Merely write the number of the question in the margin.

You MUST NOT take this QUESTION/ANSWER BOOKLET away from the examination room.

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## SECTION A

Suggested time: 40 minutes (30 marks)

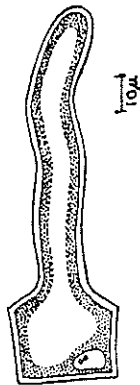
Select the statement which best answers the question.

Record each answer for questions 1-30 by marking your choice of alternatives on the Separate Multiple Choice Answer Sheet using a '2B' pencil.

If you want to change an answer, rub out your first answer and mark your new one.

The Separate Answer Sheet for this Section will be collected separately by the Supervisor.

1. The diagram below shows a student's drawing of a cell seen under high power of a microscope.



It is probable that the student was looking at

- (a) an animal cell.
- (b) a cell obtained from conducting tissue.
- (c) a cell with an absorptive function.
- (d) a photosynthetic cell.

2. In the alimentary canal

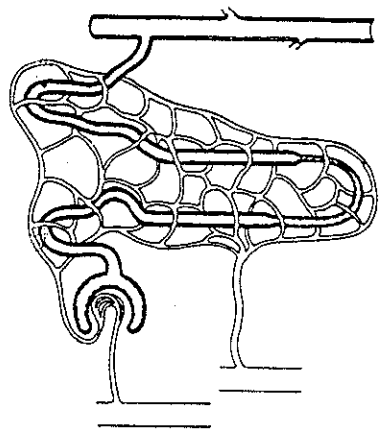
- (a) muscular layers are involved in the peristaltic movement of food along the digestive tract.
- (b) microvilli decrease the surface area which assists in the absorption of the products of digestion.
- (c) the pH of the contents remains constant along its length.
- (d) inorganic molecules within the lumen of the small intestine are broken down by enzymes secreted by intestinal glands.

3. Which one of the following experimental observations provides evidence that roots absorb mineral ions by active transport rather than by diffusion?

- (a) The rate of respiration in root cells increases when roots are transferred from distilled water to a dilute mineral ion solution.
- (b) Mineral ion uptake by roots is rapid when transpiration rate is high.
- (c) The rate of absorption of mineral ions by root cells increases when roots are transferred from a dilute solution to a more concentrated solution.
- (d) Mineral ion uptake is more rapid in the parts of roots where root hairs are abundant.

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Use this diagram of a human nephron to answer question 6.



6. Which one of the following describes the pathway of a waste molecule which is excreted by the kidney?

- (a) Bowman's capsule → Glomerulus → Tubule → Ureter → Bladder → Urethra
- (b) Glomerulus → Bowman's capsule → Tubule → Urethra → Bladder → Ureter
- (c) Bowman's capsule → Glomerulus → Tubule → Urethra → Bladder → Ureter
- (d) Glomerulus → Bowman's capsule → Tubule → Ureter → Bladder → Urethra

7. One mitotic division of a diploid cell results in the formation of daughter cells with

- (a) identical genotypes and half as many chromosomes as the parent cell.
- (b) non-identical genotypes and half as many chromosomes as the parent cell.
- (c) identical genotypes and the same number of chromosomes as the parent cell.
- (d) non-identical genotypes and the same number of chromosomes as the parent cell.

SEE PAGE 6

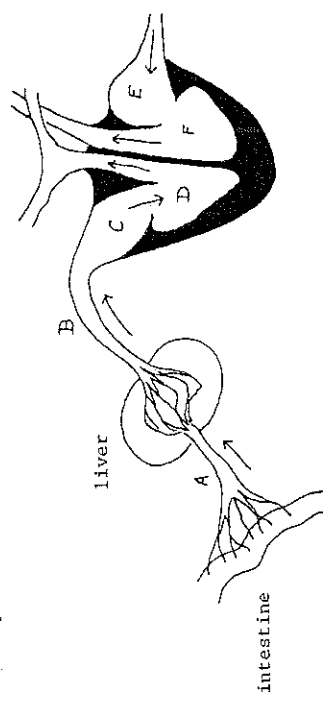
4. In order to determine what weather conditions stimulate earthworms to feed, leaf fragments were scattered within a one metre square of lawn. The results of a week's observations are summarised in the following table.

Day	Minimum Temperature	Weather Conditions at Night	No. of leaf fragments taken
Monday	10°C	Wet Windy Cloudy	6
Tuesday	9°C	Dry Calm Bright	None
Wednesday	18°C	Dry Windy Cloudy	7
Thursday	9°C	Wet Calm Cloudy	3
Friday	15°C	Wet Windy Cloudy	10

From the above data, which factor seems to have the most effect on earthworm feeding?

- (a) Heat
- (b) Wind
- (c) Moisture
- (d) Cloud

5. The diagram represents the heart, liver, portion of the intestine and certain blood vessels in a mammal. The direction of blood flow is indicated by the arrows.



In such an animal

- (a) blood in vessel B carries a lower concentration of nitrogenous waste than blood in vessel A.
- (b) blood leaving chamber F will reach the lungs before blood leaving chamber D.
- (c) blood entering chamber E will contain a lower concentration of glucose than blood entering chamber C.
- (d) blood entering chamber E will contain a higher concentration of carbon dioxide than blood in chamber D.

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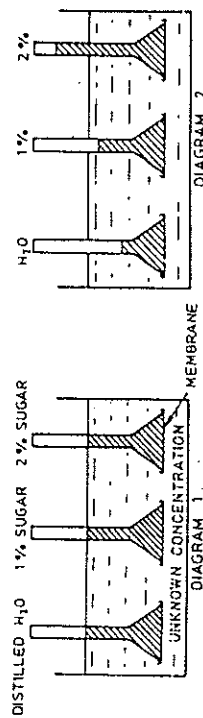
8. Consider two pumpkins growing on the same plant. One was enclosed at the start of its development in an aluminium foil bag and the other enclosed in a clear plastic bag. Both bags allowed the passage of oxygen, carbon dioxide and water vapour. The pumpkins grew over the same period of time in otherwise identical conditions and at the end of several months the results obtained were as follows:

	Pumpkin mass	
	Start of experiment	End of experiment
Aluminium foil	5g	4900g
Clear plastic	5g	5000g

You could reasonably conclude that

- photosynthetic activity of the pumpkin fruit plays a large part in pumpkin growth.
- the difference in pumpkin mass is due to the higher rate of respiration by the pumpkin in the aluminium foil.
- most of the mass in each of the pumpkins would be due to minerals imported via the xylem.
- most of the mass of the two pumpkins would have been derived from material imported via the phloem.

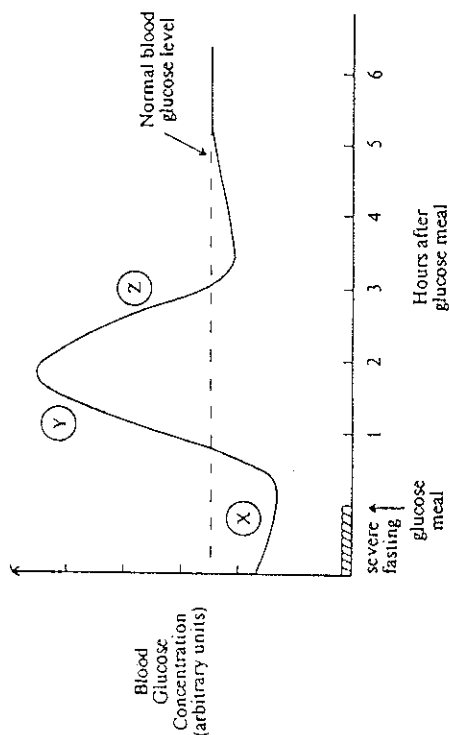
9. Three funnels were covered with a semi-permeable membrane and were set up in a large container in a sugar solution of unknown concentration. The first funnel was filled with distilled water, the second with 1% sugar solution, and the third with 2% sugar solution, as shown in Diagram 1. After several hours, the levels of the liquids in the funnels were noted, as shown in Diagram 2.



From these results it can be stated that the concentration of the sugar solution in the large container was

- less than 1%.
- equal to 1%.
- between 1% and 2%.
- equal to 2%.

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This graph shows the blood glucose levels of a person at certain times:

- during severe fasting,
- 1-2 hours after a glucose meal, and
- 2-3 hours after the meal.

It is reasonable to expect that to restore blood glucose levels the following processes would be occurring in the liver

- metabolism of glucose to fats at (Z).
- conversion of glucose to glycogen at (X).
- metabolism of proteins to amino acids and then to glucose at (X).
- storage of glycogen at (Y).

11. Plant cells differ from animal cells in that they have

- centrioles, large vacuoles, Golgi bodies.
- large vacuoles, cell walls, chloroplasts.
- mitochondria, nucleoli, large vacuoles.
- mitochondria, food vacuoles, cell walls.

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Questions 12 and 13 below are based on the following:

Eucalyptus oil (EO) is believed to prevent colds. To test this belief 20,000 volunteers were divided into four groups and each individual took a dose every morning for one year.

Group	Number in Group	Contents of Dose	Volunteers who developed colds (%)
I	4750	5 grams of sugar	20
II	4750	5 grams of sugar + 1 gram of EO	19
III	4750	5 grams of sugar + 3 grams of EO	21
IV	5750	5 grams of sugar + 9 grams of EO	10

12. Which group served as the control for this experiment?

- (a) I
- (b) II
- (c) III
- (d) IV

13. From the results of this experiment we can conclude that

- (a) sugar reduced the number of colds.
- (b) sugar increased the number of colds.
- (c) sugar + 3 g or less of EO proved ineffective in the prevention of colds.
- (d) 9 g of EO is effective against colds.

14. If a person's pancreas was surgically removed, an expected initial outcome would be a

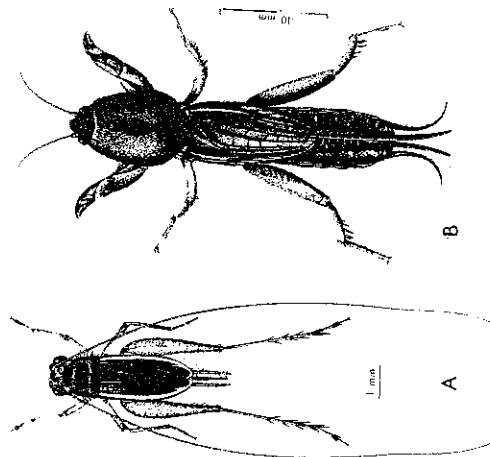
- (a) high concentration of glucose in the blood and urine.
- (b) normal concentration of glucose in the blood and a high concentration in the urine.
- (c) high concentration of glucose in the blood and a low concentration in the urine.
- (d) low concentration of glucose in both blood and urine.

15. Which of the following reactions is endergonic?

- (a) glucose  $\rightarrow$  alcohol + carbon dioxide
- (b) lactic acid  $\rightarrow$  carbon dioxide + water
- (c) carbon dioxide + water  $\rightarrow$  glucose
- (d) protein  $\rightarrow$  amino acids.

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16. The following are diagrams of two crickets:



Which of these two would most likely be found underground, and why?

- (a) Specimen A because its powerful hind legs can push sand aside quickly.
- (b) Specimen B because its short fore limbs can be used for digging.
- (c) Specimen B because the antennae are too short for survival on the surface.
- (d) Specimen A because its large eyes will enable it to see better in the dark.

17. The table below gives the results of an experiment to find the effect of light and darkness on the germination of two types of lettuce seeds.

Condition	Germination of type X seeds (%)	Germination of type Y seeds (%)
Continuous daylight	95	90
Continuous darkness	12.5	90
Alternate light/dark	75	87.5

What can be concluded about the effects of normal daylight and darkness on the germination of these lettuce seeds?

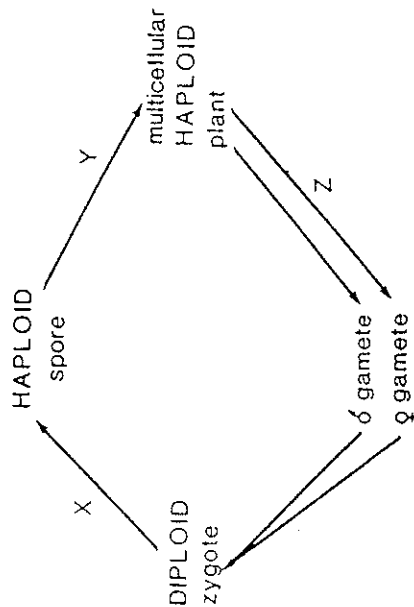
- (a) Only in the type Y seeds are developmental responses under the influence of light-sensitive chemical substances.
- (b) Neither type X seeds nor type Y seeds require light for germination.
- (c) Daylight promotes the germination of type X seeds.
- (d) The effect of light on the germination of lettuce seeds is reversible.

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18. The cells of multicellular eukaryotic unicellular eukaryotic organisms are different from unicellular eukaryotic organisms in that they

(a) contain organelles.  
 (b) have a nucleus.  
 (c) are not membrane bounded.  
 (d) have specialized functions.

19. In the life cycle of some plants, the diploid phase is represented only by the zygote, which quickly divides to produce haploid spores. This life cycle is represented in the diagram below.



Which one of the following combinations correctly identifies the processes occurring at X, Y and Z?

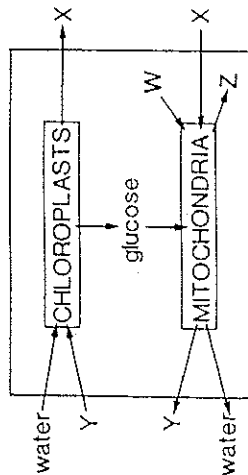
X : Y : Z

(a)	meiosis	: mitosis	: meiosis
(b)	meiosis	: mitosis	: mitosis
(c)	mitosis	: meiosis	: mitosis
(d)	mitosis	: mitosis	: meiosis

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20. A greater number of enzymes is involved in the completion of aerobic respiration than in anaerobic respiration because
- (a) aerobic respiration involves a greater number of chemical reactions.  
 (b) aerobic respiration produces more energy.  
 (c) anaerobic respiration only takes place at night.  
 (d) aerobic respiration is carried out by more complex organisms.

21. The diagram summarises some of the chemical activities which occur in a green plant cell.



Which one of the following combinations correctly identifies the chemical compounds W, X, Y and Z?

W : X : Y : Z

(a)	ATP	: CO <sub>2</sub>	: O <sub>2</sub>	: ADP
(b)	ADP	: O <sub>2</sub>	: CO <sub>2</sub>	: ATP
(c)	ADP	: CO <sub>2</sub>	: O <sub>2</sub>	: ATP
(d)	ATP	: O <sub>2</sub>	: CO <sub>2</sub>	: ADP

22. Of the following, the most important step which can give rise to the evolution of a new species, rather than evolution within a species, is
- (a) prevention of interbreeding by a geographic barrier.  
 (b) adaptation to a new, more suitable environment.  
 (c) sudden appearance and multiplication of new forms.  
 (d) selection of individuals with particular characteristics.

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23. In a plant which has a diploid number of twenty-four ( $2n = 24$ ), flower colour is determined by a single gene. How many copies of this gene occur at each one of the poles of the spindle at the telophase I stage of meiosis of this plant?

- (a) 1
- (b) 2
- (c) 4
- (d) 24.

24. The advantage of asexual reproduction from an evolutionary point of view is that

- (a) all the offspring will be as well suited to the same environment as the parent.
- (b) dispersal to new environments is more readily accomplished.
- (c) there is less chance of the offspring showing a new double-recessive character.
- (d) it ensures the production of large numbers of offspring.

25. The alpine *Ranunculi* (buttercups) in Tasmania are interesting to classify. Two recognised species, *R. decurvus* and *R. concinnus*, differ in a very minor but obvious detail: whether the hairs on the leaves and stems are flattened (*R. decurvus*) or stick out (*R. concinnus*). *R. decurvus* is found in habitats at a lower altitude than *R. concinnus*. The two species maintain their different characteristics when cultured together at the same altitude. Which of the following statements best fits the above data?

- (a) The two species evolved differently at different altitudes.
- (b) *R. concinnus* evolved the "hairy" condition to withstand the cold.
- (c) *R. concinnus* and *R. decurvus* are the same species but grow differently at different altitudes.
- (d) Seeds resulting from a cross between the two would probably not germinate.

26. In poultry the sex chromosomes of the female are ZW and of the male are ZZ. The gene for white plumage is dominant to the gene for red plumage and is located on the Z chromosome but not the W. If a Rhode Island Red male is crossed with a light Sussex (White) female, the baby chicks are easily distinguished as males or females because

- (a) all male chicks would be white and all female chicks red.
- (b) all female chicks would be white and all male chicks red.
- (c) three-quarters of the chicks would be white and the other quarter red.
- (d) all female chicks would show the dominant characteristic whereas all male chicks would show the recessive.

27. A mutation is best described as

- (a) treatment by a certain amount of radiation.
- (b) a relatively permanent change in the genetic material.
- (c) a relatively permanent change in the mitotic process.
- (d) a new characteristic appearing in an organism.

28. In a natural population over many generations, the process of natural selection is likely to result in an overall change in the population so that the population as a whole becomes better adapted to the conditions in which it lives and reproduces. Which of the following is an example of such a change?

- (a) Swallows migrating each year from the northern hemisphere to the southern hemisphere.
- (b) When a hot water waste drain from a factory was installed, the oysters on the nearby rocks died and were replaced by mussels.
- (c) Snails in a rain forest have darker shells than snails of the same species found in an adjoining open forest.
- (d) A kookaburra population increases in number shortly after a rapid increase in the lizard population in the same area.

29. Two tribes of *Homo sapiens*, each living at sea level in quite distinct areas, and each isolated from other tribes, are about to be investigated by an anthropologist. The tribes have been isolated for thousands of years during which time climatic conditions have remained unchanged. Tribe A lives in an open, hot desert region. Tribe B lives in a cold, sub-Arctic region. The anthropologist would be reasonable in predicting that, as a result of selection,

- (a) the mean limb length of Tribe A people would be less than that of Tribe B people.
- (b) there would be a significant difference in the mean size of the cerebral hemispheres in people of Tribes A and B.
- (c) the mean ratio of body surface area to volume of Tribe A people would be greater than that of Tribe B people.
- (d) the skin pigmentation would be darker in Tribe B people than in Tribe A people.

30. A number of developments in biological knowledge and technology have resulted in an increase in food production. Which of the following would NOT be one of these, in the long term?

- (a) The use of selective breeding.
- (b) Improved use of irrigation.
- (c) The development and use of fertilisers.
- (d) Clearing of land in low rainfall areas.

END OF SECTION A

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SEE PAGE 13

## SECTION B

Suggested time: 90 minutes (46 marks)

Attempt all questions in the section.

Write your answers in the spaces provided.

Use a black or blue pen or biro when answering Sections B and C.

31. (8 marks)

A biologist who was interested in the effect of light intensity on the rate of photosynthesis took a number of tomato plants, enclosed them in a glass container, and shone light of known intensity on the plants. He measured the rate of photosynthesis of the plants by determining the total volume of carbon dioxide absorbed (in microlitres per minute). He then calculated the average rate of photosynthesis by dividing his answer by the number of plants.

He repeated the procedure using a wide range of light intensities and obtained readings of carbon dioxide uptake for each light intensity. His results are summarized below:

Light Intensity (lux) X	Carbon Dioxide Uptake (Av. microl./min.) Y	Ratio $\frac{Y}{X}$
1000	23	0.0230
2000	38	0.0190
3000	60	0.0200
4000	84	0.0210
5000	96	0.0232
6000	122	0.0203
7000	138	0.0197
8000	159	0.0199

(a) What do the Y/X ratios indicate about the relationship between carbon dioxide uptake and light intensity?

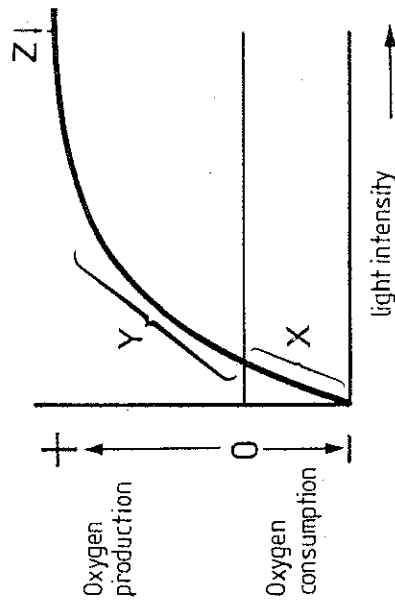
(b) Predict the carbon dioxide uptake which would be measured at light intensities of 5500 and 12000 lux. How confident of each of these predictions can you be? Explain why. (Graph paper is provided on page 43 of the exam booklet for your use if you require it.)

(c) State three (3) other environmental variables which should concern the biologist making these measurements.

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## Question 31 (continued)

The relationship between oxygen production, oxygen consumption and light intensity in a plant is shown in the diagram below.



(d) Explain what is happening in the plant to produce

(i) the pattern of oxygen consumption at X.

(ii) the pattern of oxygen production at Y.

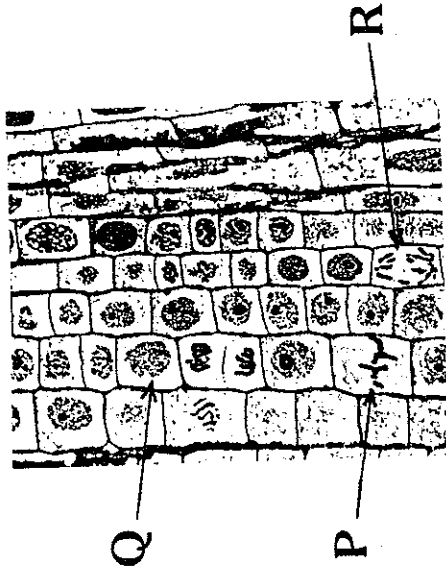
(e) At point Z on the graph increasing light intensity no longer causes an increase in the rate of oxygen production. How could this rate be increased above the level at Z?

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32. (4 marks)

The photomicrograph below shows three cells P, Q and R at different stages of mitotic cell division.



(a) Describe TWO events which have occurred between stages P and R.

(b) Cells such as Q do not appear to be undergoing division. They are said to be in the interphase or "resting" stage. What is happening to the nuclear material at this stage?

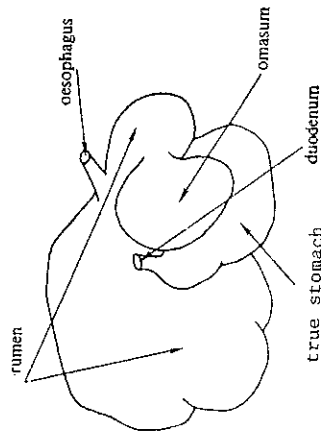
(c) Even though they may differentiate into cells which appear quite different from one another, all cells produced by mitosis are usually identical in one way. In what way are the cells identical?

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33. (5 marks)

Cellulose is a polysaccharide made of glucose molecules joined in such a way that it cannot be digested by any known mammalian enzyme. However, some bacteria and protozoa produce a 'cellulase' or cellulose-digesting enzyme. In ruminant animals like cows, vast numbers of bacteria occur in a much enlarged region of the stomach called the rumen. Here, food which has been eaten is stored for long periods during which it is regurgitated back into the mouth, chewed again, and returned to the rumen. Nearly all the protein in the food is used by the bacteria for growth and reproduction. There are no enzymes produced by the rumen.

At intervals a liquid containing fine particles and bacteria is passed from the rumen into the omasum, which squeezes excess fluid back into the rumen, before the rest passes on into the true stomach. The true stomach secretes gastric juice and here bacteria are digested.



(a) Suggest one advantage to ruminants of each of the following:

(i) the abundance of bacteria in the rumen

(ii) the size of the rumen

(iii) the regurgitation of food from the rumen

(iv) the removal of excess fluid before food is passed to the true stomach

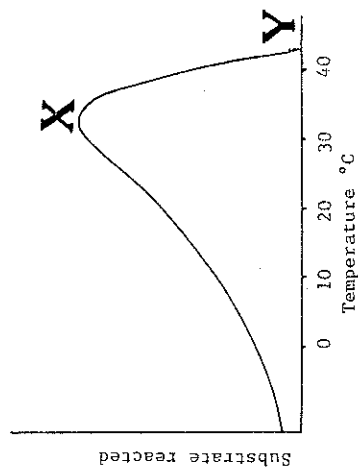
(b) Explain how the cow obtains protein for its own metabolism from the cellulose food intake

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34. (3 marks)

The activity of enzymes is affected by various factors. The graph below shows how the activity of an enzyme from an organism is affected by temperature.

GRAPH 1



(a) What would be the normal temperature for this organism? Explain.

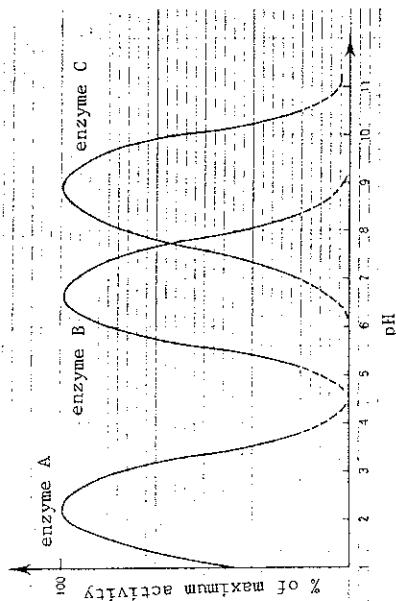
(b) What is the cause of the decline shown by the graph between X and Y?

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Question 34. (continued)

The graph below shows the effect of pH on the activity of three digestive enzymes.

GRAPH 2



(c) Which enzyme is most effective in neutral solutions?

(d) Which enzyme A, B or C could be salivary amylase?

(e) What generalisation about enzyme activity is shown by Graph 2?

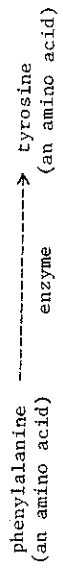
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35. (7 marks)

Phenylketonuria (PKU) is a metabolic disorder which is characterised by the inability to produce the enzyme phenylalanine hydroxylase. It is inherited as an autosomal recessive trait. The gene controlling the production of the enzyme has two forms:

- E enzyme produced
- e enzyme not produced.

When the enzyme is present it catalyses the following reaction:



When the enzyme is absent, phenylalanine is not broken down and accumulates in the blood and other tissues.

Children born with PKU will suffer mental and physical retardation unless they are placed on a special diet early after birth. They are kept on this diet until they are about 10 years of age, after which time high blood levels of phenylalanine generally have no harmful effect.

(a) If you were planning a diet for a child with PKU, what precautions would you take with the diet? Explain.

(b) John and Betty are both able to produce the enzyme. They have a son, Thomas, who has PKU.

(i) What genotypes do John and Betty have?

(ii) If they had another child, what chance is there that he or she would also have PKU? Show your working.

(iii) Their other son, David, can produce the enzyme. What is the chance that David is heterozygous for PKU?

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Question 35 (continued)

(c) Thomas was placed on a special diet shortly after birth and so developed normally. He married Sally who was able to produce the enzyme but has a father with PKU.

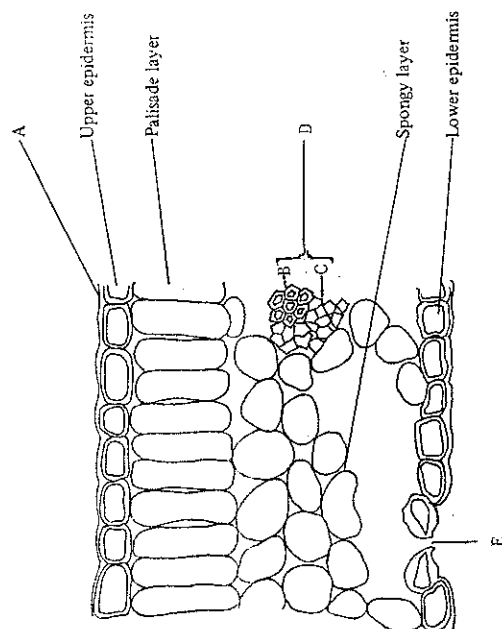
What is the chance that the first child of Thomas and Sally will have PKU? Show your working.

(d) Although children can be taken off the special diet at about 10 years of age, it is found that a female with PKU will have a mentally retarded child unless she goes back on the diet before and during pregnancy. This happens irrespective of the genotype of the child. Suggest an explanation for this observation.

SEE PAGE 22

36. (7 marks)

The diagram below represents a transverse section of a dicotyledonous leaf. Examine the diagram carefully and answer the following questions.



(a) Which cells contain most chloroplasts?

(b) What is the function of the chlorophyll present in the chloroplasts?

(c) Give a name for the structure labelled A, and suggest two ways the leaf would be affected if it was absent.

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Question 36 (cont.)

(d) There are two types of tissue in the structure labelled D. State three functions for structure D, related to the two tissues found in it.

(e) Name two gases that pass out of the structure labelled E during daylight.

(f) If a plant of which this leaf was a part was watered with a solution containing radioactive phosphorus, in which of the structures in the diagram on page 22 would you first expect to find radioactivity?

(g) The cells on either side of structure E control the size of the opening. Explain what changes would occur in these cells during the course of a hot summer day.

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37. (6 marks)

An investigation of the ability to survive without water was conducted using 10 laboratory rats (*Rattus norvegicus*) and 10 desert hopping mice (*Notomys alexis*). For three days, 5 rats and 5 hopping mice were given plenty of food but no water. The remaining rats and hopping mice had both food and water. Measurements were made of their water intake and output as shown in the table below.

Table 1: Mean water intake and output for *Notomys alexis* and *Rattus norvegicus*, when supplied with or deprived of drinking water.

Animal	No.	Drink- ing water avail- ability	ml H <sub>2</sub> O/100g bodyweight x day					Net gain or loss in water	
			Water gain		Water loss				
			Drink- ing	Meta- bolic	From food	Faeces	Evapora- tion		Urine
<i>R. nor- vegicus</i>	5	present	9.0	3.0	4.4	2.0	4.6	7.7	
<i>R. nor- vegicus</i>	5	absent	0.0	1.7	3.7	1.4	5.1	5.2	
<i>N. alexis</i>	5	present	2.6	2.4	9.6	0.2	11.5	0.2	
<i>N. alexis</i>	5	absent	0.0	1.8	6.5	0.1	6.5	0.2	

(a) Complete Table 1 by calculating the net gain or loss of weight per day.

(b) Which of the two species in the above experiment adjusts more successfully to lack of water supply? What evidence do you have for your choice?

Question 37 (continued)

- (c) Other investigators found that hopping mice can increase body weight when fed only dry food with no water. Is this observation consistent with the data in the table below?

Table 2: Mean body weights for *Notomys alexis* and *Rattus norvegicus* on three successive days

Animal	Number	Drinking water availability	Mean body weight (grams)		
			Day 1	Day 2	Day 3
<i>R. norvegicus</i>	5	present	197.4	200.4	201.1
<i>R. norvegicus</i>	5	absent	245.5	242.1	236.5
<i>N. alexis</i>	5	present	45.5	44.0	44.2
<i>N. alexis</i>	5	absent	35.4	34.6	35.4

(d) From the evidence provided in this question, what seems to be the process by which hopping mice conserve water?

(e) Suggest how hopping mice would behave in their natural environment, so as to further conserve water loss in dry seasons.

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38. (6 marks)

Two adjacent mature trees of New England peppermint (*Eucalyptus nova-anglica*) growing near each other, were harvested with the aid of a cherry-picker to determine in them the distribution of biomass and insect damage.

The trees were carefully chosen as a matched pair - approximately the same height and age and growing in the same soil and water conditions. However, one tree showed symptoms of dieback disease. The space which each tree occupied was divided into cubic metres, and 10 samples of leaf or wood or root were taken to determine the amount of tree biomass in each cubic metre. The distribution of tree biomass was found to be as shown in the diagram below.

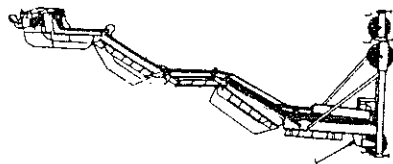


Fig. 1. Cherry-picker

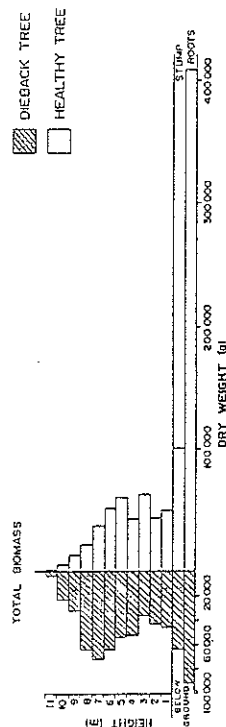


Fig. 2. Comparison of the distributions of biomass for the healthy and dieback trees.

(a) Write one hypothesis that the biologists could be testing in this investigation.

(b) Which part of the tree is directly attacked by the "dieback disease"? What evidence is there that this attack has occurred?

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Question 38 (continued)

It was found that the healthy tree had three times as much leaf biomass as the diseased tree and that more of this biomass was at a lower level in the tree.

(c) Propose a hypothesis to account for the effect of dieback disease on the mass and distribution of living leaves in the tree.

On examining the wood of the two trees, the biologists found that 19% of the branches of the dieback-affected tree had borers in them, while 5% of the branches of the healthy tree had borers in them. There were also more insect larvae in the roots of the diseased tree. Other evidence shows that insects often eat diseased leaves entirely away whereas healthy leaves are only partly eaten.

(d) Write an explanation for the interactions between the tree, the dieback disease, and the insects.

END OF SECTION B

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## SECTION C

Suggested time: 50 minutes (24 marks)

There are TWO questions, each worth 12 marks. There are THREE alternatives to each question. Choose ONE alternative from each question.

Answer both questions in essay form. Write your answers on the sheets provided at the end of this section. Where possible, support your answers with clearly labelled diagrams. TWO marks may be deducted from each answer which is poorly presented, set out in point form or written with other than a blue or black pen or biro.

39. EITHER

- (a) The size of living organisms varies enormously. Most organisms are small compared with human beings, but some are larger. Being large could be advantageous or disadvantageous to an organism.
- (i) Explain the advantages and disadvantages of large size to both plants and animals.
- (ii) Using a named large plant or animal, explain how each of the disadvantages of large size have been overcome in this species.

OR

- (b) Consider the following statement:

"The wombat is thought to have evolved from a tree-living ancestor. After leaving the trees, these ancestors began digging in the ground in search of food. The exercise strengthened their leg muscles and claws, and sharpened their teeth. These changes, inherited and improved upon through many generations, resulted in the modern animal, with its powerful stumpy legs, highly specialised digging claws capable of burrowing into earth, and sharp incisors for cutting roots."

The explanation given above for changes in the structure of the ancestors which gave rise to wombats is not generally considered by biologists to be acceptable, given the current evidence.

- (i) Write an explanation for how changes such as these occurred, in terms which would be acceptable to modern biologists.
- (ii) Describe the scientific evidence which supports one explanation and refutes the other.

OR

- (c) Cells are functional units of living organisms, and in order to maintain life, all cells must carry out a number of processes such as the release and utilization of energy and growth and repair of tissues. Cells contain a variety of structures which enable them to carry out these processes.

Describe these cell structures and the functions they perform.

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40. EITHER

- (a) Many terrestrial plants are erect in form. Discuss the factors and tissues which are involved in keeping erect:

- (i) a young seedling, and  
(ii) a mature tree.

Explain where the tissues are located in the body of the plant, and what other functions these tissues perform.

OR

- (b) Lungs and leaves are organs which exchange the gases oxygen, carbon dioxide and water vapour with the environment.

- (i) Explain how the structural features of each organ help in the exchange of gases.

- (ii) Describe the control mechanisms which are involved in regulating the passage of these substances in and out of the organs.

- (iii) How is the exchange of these gases involved in regulating temperature?

OR

- (c) The following extracts are taken from the diary of a Year 12 student:

"Jan. 17th. Visited the Doctor today. When he tested my reflexes, I kicked so hard that I knocked over a stool. Weight 68 kg, height 169.1 cm."

"Jan. 31st. After 17 successive centuries (38°C and above), the maximum today is 20°C. I am shivering as I write this and my skin is much paler than it has been."

"Jun. 25th. Measured my height and weight again today. Height 171.2 cm, weight 72.5 kg."

Explain the functioning of the various control systems of the body which would have been involved in each of the changes described in these diary extracts.

END OF PAPER